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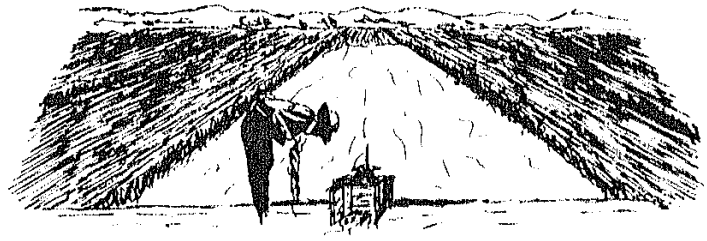
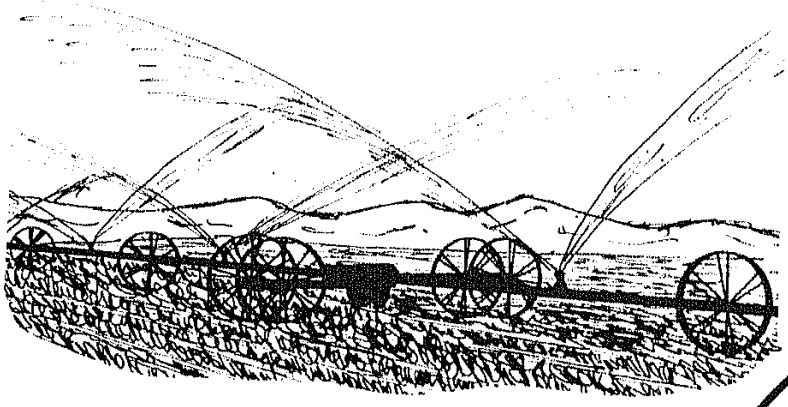


BIG SANDY RIVER



Colorado River Basin

Salinity Control Study

BIG SANDY RIVER UNIT SALINITY STUDY
WYOMING

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SUMMARY

The Big Sandy River Unit of the Colorado River Basin Salinity Control Program is predominately an agricultural area containing about 1,227,500 acres. This area, consisting of portions of three counties, Fremont, Sublette, and Sweetwater, is primarily utilized by livestock, both cattle and sheep. Located within the approximate center of the area is the Eden Valley Irrigation Project, the subject of this salinity control study by the U.S. Department of Agriculture (USDA).

Irrigation was introduced in the valley in 1886, when settlers were issued permits to divert water from the Big Sandy River. Due to project actions beginning with the Eden Irrigation and Land Company in the early 1900's, the Rock Springs Land and Water Company and the Wyoming Land and Water Company in the 1930's, and the existing Eden Valley Irrigation and Drainage District, there has been an increase of irrigated land in Eden Valley to the present 15,700 acres. During 1962-1973, the Eden Valley irrigation project served an average of 84 farms, averaging 173 acres per farm. Total farm population is 279 people; 79 of the 84 operators currently are part-time farmers.

Mineral resources in the upper Green River Basin and the emphasis that is being placed on those resources have produced an intensification of mineral investigations in the Big Sandy River Unit Study Area. These investigations have included seismographic studies using the drilling and explosive charge technique. There are no mines in the Study Area at the present time.

Under the Colorado River Basin Salinity Control Act (Public Law 93-320), USDA's Soil Conservation Service (SCS) had the responsibility for studying the effects of on-farm irrigation improvements to reduce salinity loadings to the Colorado River. Under the same authority, Interior's Water and Power Resources Service (WPRS), formerly the Bureau of Reclamation, is currently studying off-farm conveyance and storage system improvements and their effects on salinity contributions to the Colorado River.

In carrying out this study, basic data was gathered from the WPRS, United States Geological Survey, Bureau of Land Management, Wyoming State Engineer's Office, Water Resources Research Institute of Wyoming, and the Eden Valley Irrigation and Drainage District. SCS conducted special surveys and investigations to obtain other necessary data for this study. These included discussions with farmers to inventory present irrigation practices, stream and drainage flow measurements, and compiling data on the soils and geology of Eden Valley.

Using this basic data and a data base period of 1960 through 1977, it was determined that the Big Sandy River contributed about 149,200 tons of salt annually into the Green River and the Colorado River system. Most of the salt is leached from the underlying Bridger and Green River marine shale formations, and carried to the Big Sandy River by underground aquifers. Excessive irrigation on highly permeable soils and irrigation delivery system seepage provide water for deep percolation to

the underground aquifers. Of the total Big Sandy River system salt output, it is estimated that through the base period of 1960-1977 return flows from the irrigation delivery system seepage and deep percolation from on-farm irrigation practices contribute about 124,900 tons annually. Natural runoff, erosion, and seeps contributed an additional 24,300 tons annually.

A local Coordinating Committee, comprised of two board members of the Eden Valley Irrigation and Drainage District, all of the board of supervisors for the Big Sandy Conservation District, an appointed member from the Wyoming Governor's Office, and a representative from the WPRS, provided general guidance and a vehicle for local citizen input. The Coordinating Committee reviewed the basic data and recommended several on-farm irrigation management alternatives to increase irrigation efficiencies and reduce deep percolation losses. In addition, the Coordinating Committee requested that land retirement and irrigation retirement alternatives also be analyzed. Eleven separate alternatives were analyzed and presented to the Coordinating Committee and at a public meeting. As a result of the public meeting, the Coordinating Committee sent a questionnaire to all landowners to obtain their preferences.

As a result of the questionnaire and public meeting, a landowner preferred alternative (Alternative 11) and landowner preferred-modified alternative (Alternative 12) were forumulated. These alterantives were analyzed and presented at a subsequent public meeting. General consensus of the majority of landowners and the Coordinating Committee was to select the "landowner preferred-modified alternative" (Alternative 12). This modified alternative would retire from irrigation about 87 percent (13,700 acres) of the irrigated area, with 13 percent (2,000 acres) remaining under irrigation. Of the 2,000 remaining irrigated acres, nearly all will need on-farm irrigation improvements to obtain better irrigation efficiencies that will reduce losses to deep percolation. This acreage would be supplied water by three pumps and distribution pipelines direct from the Big Sandy River rather than through the existing delivery system.

Alternative 2 - Improved Water Management and Minimum Structural Improvements

Alternative 3 - Entire Project Area Sprinkler Irrigated (pumping plant and pipeline distribution system)

Alternative 3A - Entire Project Area Sprinkler Irrigated (six separate pumping plants and distribution systems)

Alternative 3B - Entire Project Area Sprinkler Irrigated (individual on-farm pumping)

Alternative 4 - 14,200 Acres Irrigated with Automated Border Systems and 1,500 Acres Sprinkler Irrigated

Alternative 5 - 50 Percent of Cropland Irrigated by Automated Border Systems and 50 Percent Irrigated by Sprinkler Systems

Alternative 6 - Land Retirement (acquisition of private land)

Alternative 8 - Irrigation Retirement (livestock operation) - (NED)

Alternative 9 - Irrigation Water Reduction (reduced water delivery)

Alternative 10 - Pump Saline Well Water to Sublettes Flat for Evaporation

Alternative 11 - Landowner Preferred (combination of alternatives)

Alternative 12 - Landowner Preferred-Modified (combination of alternatives, with three pumping plants and pipelines)

Alternative 13 - Environmental Quality (combination of Alternative 4 and a reduced Alternative 10)

Table S-1 - Summary of Alternatives (costs, benefits, and impacts of the alternatives analyzed)

NOTE: With the exception of the irrigation retirement Alternatives 5 and 6, all alternatives evaluated and displayed in Table S-1 assumes that the existing Agricultural Conservation programs as administered by the Agricultural Stabilization and Conservation Service (ASCS), with technical assistance provided by the Soil Conservation Service (SCS), will continue to be offered and utilized at the same rate as in the past few years.

Alternatives 2 through 13, as displayed in Table S-1, used Alternative 1 Future Without a Project (No Action) as an evaluation base. All values shown in the table are incremental to Alternative 1.

Table S-1 Summary of Alternatives - Big Sandy River Unit Salinity Study, Wyoming

ITEM	1	2	3	3A	3B	4	5	6	8 NED	9A 2/	9B 2/	10	11	12	13 10
Annual Installation Cost - $Million	.042 1/	.08	5.58	2.71	.99	.86	.98	2.20	1.63	1.42	.58	.83	2.73	2.53	1.42
Annual OM&R Cost - $Million	.058 1/	.04	.75	.71	.62	.56	.60	0	0	0	0	.32	.83	.10	.76
Annual Cost Wildlife Habitat Mitigation 3/ - $Million	0	.04	.14	.14	.14	.05	.09	.14	.14	.05	.05	0	.14	.10	0
Total Annual Cost-$Million	.10	.16	6.77	3.56	1.75	1.47	1.59	2.34	1.83	1.47	.63	1.15	3.40	2.79	2.18
Annual Salinity Reduction Benefits 4/ - $Million	- - 7/	.10	5.00	2.62	2.62	2.16	2.42	7.51	7.51	2.16	1.01	3.36	4.52	6.71	3.92
Increased Agricultural Benefits - $Million	- - 7/	.13	.27	.27	.27	.34	.31	0	0	.34	0	0	.03	.03	.34
Total Annual Benefits - $Million	- - 7/	.23	5.27	2.89	2.89	2.50	2.73	7.51	7.51	2.50	1.01	3.36	4.55	6.74	4.26
Net Benefits - $Million	- - 7/	.07	-1.50	-.67	1.14	1.03	1.14	5.17	5.68	1.03	.38	2.21	2.15	3.95	2.08
Salt Load Reduction (X 1,000 Tons)	- - 7/	2.7	96.3	52.9	52.9	42.5	48.0	124.9	124.9	42.9	12.3	81.3	70.2	113.4	84.2
Salinity Reduction at Imperial Dam (mg/l)	- - 7/	.2	10.5	5.5	5.5	4.5	5.1	16.0	16.0	4.5	2.2	6.9	9.7	14.3	8.2
Annual Cost Per Ton of Salt Reduction ($)	- - 7/	59.30	70.20	67.20	33.00	34.40	33.00	18.80	14.70	34.40	46.90	14.20	34.20	24.50	25.90
Wetlands--Gain(+) or Loss(-) (1,000 Ac.) Altered / Only	0 / 0	0 / 3.63	-2.77 / 1.01	-2.77 / 1.01	-2.77 / 1.01	-.13 / 3.50	-1.20 / 2.40	-2.77 / 1.01	-2.77 / 1.01	-.13 / 3.50	-.13 / 3.50	+8.02 / 0	-2.41 / 1.36	-2.77 / 1.01	+4.01 / 3.50
Mitigation--preserve and enhance wetlands(1,000 Ac)	0	.18	.86	.86	.86	.18	.36	.86	.86	.18	.18	0	.86	.86	0
Increased Terrestrial Habitat (adjacent to wetlands)--(1,000 Ac.)	0	.09	.43	.43	.43	.09	.18	.42	.42	.09	.09	0	.43	.43	0
Streamflow Increase/Decrease (1,000 AcFt)	0	.7	+4.2	-.2	-.2	+.8	+.6	+26.2	+26.2	+7.8	+.7	-13.4	+20.6	+21.6	-4.1

1/ Good irrigation water management practices.

2/ Poor irrigation water management practices.

3/ Annual cost wildlife mitigation includes acquistion, installation, operation, maintenance, and replacement costs.

4/ Annual salinity reduction benefits are based on $416,000 per mg/l change at Imperial Dam and $12,495 per mg/l change at Green River, Wyoming.
7 See Page 4-7 for details.

5/ Annual funds expended in the project area from existing Conservation Programs. These include $25,500 ($12,200 Agricultural Conservation Program ASCS) ($13,300 Landowners) for installation of conservation measures. Technical assistance provided by the SCS annually is $16,500.

6/ Annual operation, maintenance, and replacement cost of the Eden Valley Irrigation and Drainage District.

7/ Continued installation of conservation practices at the present level will maintain on-farm irrigation efficiencies at 35 percent. Continuation of present level OM&R on the irrigation system will maintain the 82 percent conveyance efficiency. With conveyance, and on-farm efficiencies remaining essentially the same in the future, no salinity reduction or agricultural benefits are shown in the table. It is recognized that should the ongoing conservation program funding or OM&R be reduced, irrigation efficiencies may reduce a small amount which may result in a small increase of salt from the project area.

Implementation of the Landowner Preferred-Modified Alternative (Alternative 12) would result in a reduction of 113,370 tons of salt per year in the Big Sandy River, a decrease in salinity in the Green River at the town of Green River, Wyoming, of 60.92 milligrams per liter, and a decrease of 14.30 milligrams per liter at Imperial Dam, on the lower Colorado River. The land remaining under irrigation would also have a benefit of increased crop yield. No range or forest land would be treated under this alternative. Mitigation would be provided to offset the significant wildlife, wetland, and upland game habitat that would be impacted. No known unique cultural, historical, archeological, or natural resource would be disturbed by the implementation of this alternative. Prior to implementation, a cultural resource inventory will be made and regulations concerning historic and cultural properties will be complied with.

The total estimated cost of implementing Alternative 12 would be about $35.9 million. This includes approximately $28.8 million for irrigation retirement on 13,700 acres, $5.5 million for structural improvements of the irrigation systems on the remaining 2,000 acres, and $1.6 million for measures to offset the adverse effects to wetlands and associated wildlife habitat.

This study surfaced many issues in regard to the various alternatives evaluated and presented. Some of the issues which need to be considered are:

1) Special legislation for authority and funds to retire all or a substantial portion of present irrigated farmland.

2) Changes of political philosophy and/or institutional arrangements concerning water rights and alternative uses of water.

3) Implementing agencies and authorities.

4) Landowners' inability to financially pay for operation, maintenance, and replacement of on-farm irrigation system improvements.

INTRODUCTION

INTRODUCTION

Authority For Study

The Colorado River Basin Salinity Control Act (Public Law 93-320 signed June 24, 1974) provides authority for the United States Department of Agriculture (USDA) to participate in the Colorado River Basin Salinity Control Program along with the United States Department of the Interior (USDI), and the Environmental Protection Agency (EPA), in the seven Basin states of Arizona, California, Colorado, Nevada, New Mexico, Utah, and Wyoming. Title II of the Act (Section 203) directs the Secretary of the Interior to cooperate with the Secretary of Agriculture in carrying out research, demonstration projects, and in implementing on-farm irrigation improvement and water management practices and programs which will further the objectives of the Salinity Control Program upstream of Imperial Dam on the Colorado River.

The Big Sandy River Unit, Wyoming (see Figure I-1), is one of the diffused source control areas mentioned in Section 203 of the Act (Title II). This USDA study investigated the problems and formulated alternative plans to reduce salinity from the irrigated area. The alternatives developed include practices to improve on-farm irrigation efficiencies, land and irrigation retirement, and various combinations to reduce salinity.

A Memorandum of Understanding between USDI and USDA, effective November 27, 1974, was entered into under the authority of the Interdepartmental Work Service Act of March 4, 1915 (38 Stat. 1084), as amended; the Economy Act of June 30, 1932, (31 U.S.C. Sec. 686); and the Colorado River Basin Salinity Control Act of June 24, 1974, (88 Stat. 266). A Memorandum of Agreement, effective March 27, 1975, was entered into between the Water and Power Resources Service (WPRS) and the Soil Conservation Service (SCS) to implement the specific cooperative activities called for under Title II of the Colorado River Basin Salinity Control Act. SCS River Basin Surveys and Investigations are authorized under Public Law 83-566 (Section 6), with added planning authority under Public Law 93-320, Section 203(a)(1) and (b)(1).

The SCS had leadership for this USDA Study. The investigations were carried out using information developed from ongoing assistance programs, research, and demonstration projects of the WRPS, Environmental Protection Agency, Science and Education Administration, Office of Water Resources Research and Technology, University of Wyoming, and the Wyoming Natural Resources Board.

Objectives and Scope

The overall objectives of the USDA's participation in the salinity control study were: (1) to determine the contribution of salt loading from the irrigated cropland and related upland range areas; and, (2) to determine the opportunity for reducing salt loadings to the Big Sandy River and the downstream river system.

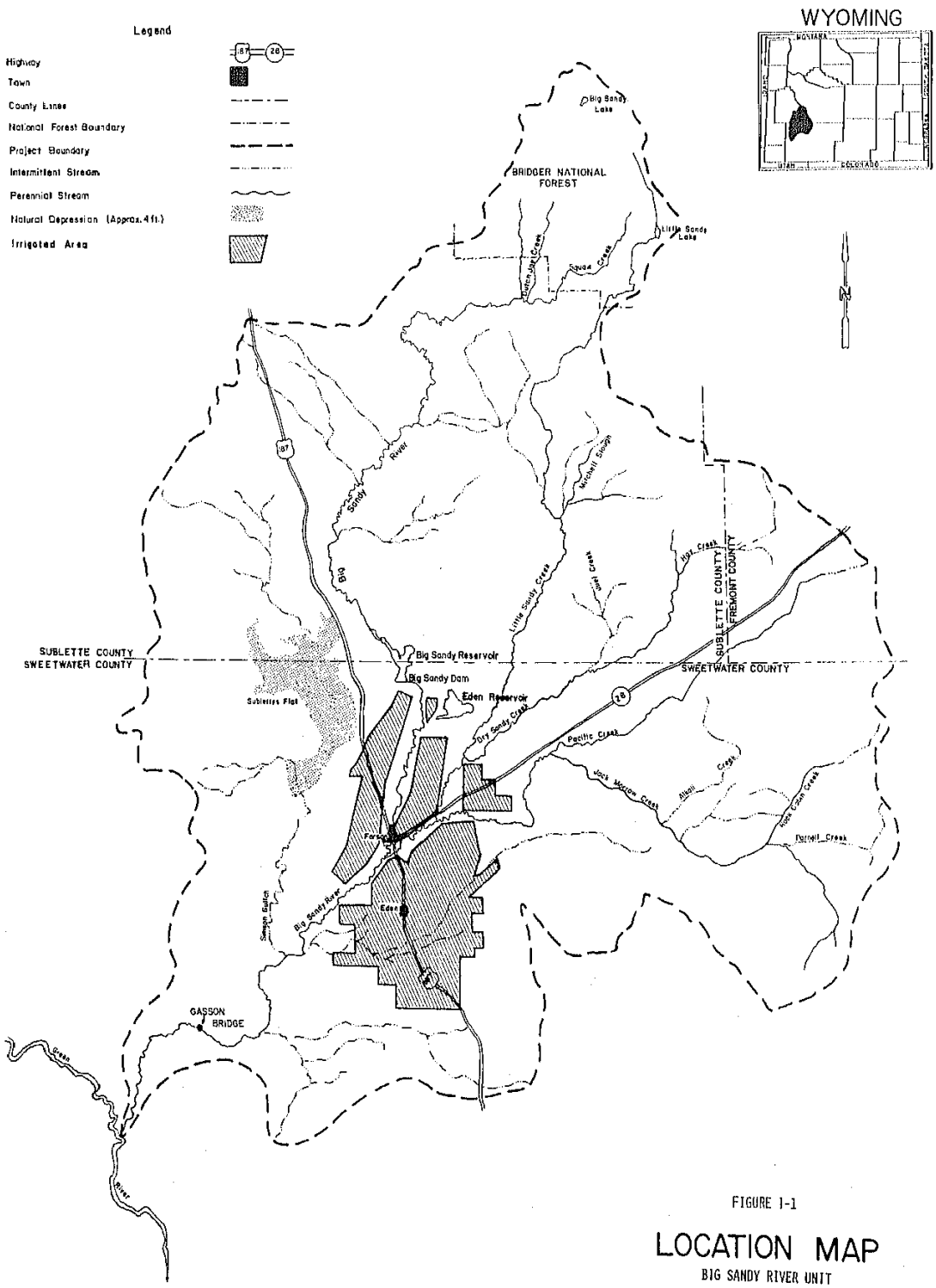

FIGURE 1-1

LOCATION MAP

BIG SANDY RIVER UNIT

FREMONT, SUBLETTE, SWEETWATER COUNTIES, WYOMING

This study meets the primary objective of salinity control planning as set forth in Public Law 93-320. Salinity control contributes to the water quality improvement aspects of the Environmental Quality (EQ) objectives, as described in the Principles and Standards for Planning Water Resources published by the U.S. Water Resources Council. Public Law 93-320 also recognizes the contributions to be made to the National Economic Development (NED) objective, since improved water quality and water conservation, have significant economic benefits. Components of the NED and EQ objectives of this study can be specified as follows:

National Economic Development (NED):

1. Reduce salt loading to the Colorado River.

2. Improve irrigation efficiencies (reduce deep percolation).

Environmental Quality (EQ):

1. Reduce salt loading to the Colorado River.

The scope of the study, through interagency participation and public involvement, provided for the development of alternatives to reduce salt loading from the Big Sandy River.

Projects and Programs of Other Agencies

The WRPS is also conducting preliminary investigations for salinity reduction for the Big Sandy River Unit. Their primary work has consisted of identifying the saline aquifers that contribute the bulk of the salt load to the Big Sandy River and determining the mechanisms by which these aquifers are recharged. The potential of intercepting these aquifers prior to their discharge into the Big Sandy River has been examined and an experiment in desalting by natural freezing was conducted.

The WPRS drilled a total of 92 test wells between 1975 and 1978 to locate and characterize the various saline aquifers. These holes range in depth from 30 to 300 feet and cover an area that extends from the Big Sandy Reservoir to the Gasson Bridge, on the Big Sandy River, a distance of about 25 miles. These wells are being monitored for water level and quality. Pumping tests have been completed on 72 of the test wells, with the remainder to be tested during 1980.

The bulk of the aquifer discharge occurs along a 15-mile reach of the Big Sandy River in the form of seeps, springs, and flowing wells, which have a total discharge of about 25 cubic feet per second. Three 15-inch diameter wells were drilled near some of the larger seeps in the "Big Bend" area between Simpson Gulch and Gasson Bridge. These wells were tested with 5-day pump tests at rates from 825 to 2,700 gallons per minute. The total dissolved solids concentration varied from 4,000 mg/l to 5,500 mg/l. The flow in the seep area was dramatically reduced during the pump tests.

Results of these pump tests indicated that large diameter, high producing wells could be used to intercept saline intrusions along the river; however, disposal of the saline water remains a major hurdle to a satisfactory salinity control project. In 1974, an atmospheric freezing experiment was attempted to separate fresh water and brine. The experimen encountered problems with maintaining equipment operating under freezing conditions, separating the brine flow, evaporation of brine, and, most importantly, pointed out the need for lined collection ponds.

The WRPS is also working with the State of Wyoming to pursue potentia uses of the saline well water. Possible Federal imvolvement might include construction and operation of facilities to capture, treat, and transport the saline waters to a potential user or disposal site.

The WPRS has proposed moving a mobile facility to the project in fiscal year 1981 to examine the saline water constituency and determine the treatment needed to produce water adequate for various purposes. While the WPRS investigations are complementary to those of the USDA, they are not expected to be completed until late in fiscal year 1984. Any on-farm salinity control measures implemented would reduce deep percolation and, consequently, reduce the quantity of saline return flow that must be accommodated downstream.

USDA's Agricultural Stabilization and Conservation Service administers the Agricultural Conservation Program, which provides limited cost-sharing funds for the installation of needed conservation practices, including irrigation improvement measures.

Science and Education Administration--Agriculture Research is able to provide assistance to the project area through data collected from other salinity project areas. This research will give Eden Valley Irrigation and Drainage District, tested and proven irrigation water management practices which will improve irrigation efficiency and reduce downstream salinity.

The Local Conservation District Program provides to the irrigation district and local landowners technical assistance for irrigation water management practices.

CHAPTER 1

CHAPTER 1

PROBLEMS AND NEEDS

Salinity Problems

Prior to irrigation, small springs along the Big Sandy River were observed by early ranchers. These springs produced minimal amounts of water and salt from the underground aquifer. However, due to irrigation and resulting deep percolation, additional water is being transported through the underground aquifer and out of the springs into the Big Sandy River. In addition, several wells have been drilled that allow water to flow into the river. This additional water is dissolving large quantities of salt from the bedrock aquifer, which is made up of the Green River and Bridger Rock formations. Table 1-1 shows the 18-year (1960 through 1977) water budget tabulation. Figure 1-1 shows a schematic flow diagram of the water budget as averaged for the 18-year period. Annual salt contributions to the Big Sandy River are shown in Table 1-2. The average annual salt loading for the 18-year period, is estimated at 149,200 tons (at Gasson Bridge).

Irrigation Systems Analysis and Management Improvement Needs

A canal and lateral system analysis was conducted for the historic water record (1960 through 1977 irrigation seasons) on the Eden Valley Irrigation Project. This analysis indicated that 82 percent of the water diverted from the reservoirs is being delivered to the farms.

The average consumptive use required by crops grown in Eden Valley was estimated to be 1.17 acre-feet per acre for the 1960-1977 evaluation period. The average irrigated acreage for this period was 14,320 acres. Dividing the consumptive use of water by crops by the total water delivered to the farm, an average on-farm irrigation efficiency of 35 percent was derived. This indicates the overall project efficiency to be approximately 29 percent, using an 82 percent conveyance efficiency (see Table 1-3).

The water not used by the irrigated crops (71 percent) can be accounted for by (1) phreatophyte use, (2) evaporation from reservoirs and ponds, and (3) drainage ditch and deep percolation return flows to the Big Sandy River.

It should be noted that the irrigated acreage has expanded with about 15,700 acres being irrigated in 1979. The land use distribution for the 15,700 acres is shown in Table 1-4.

The present land use was the basis for the water budget developed that shows the water requirements for irrigation (See Figure 1-1). The species of forage presently grown have proven to be the most efficient utilizers of water. Over long periods of time, ranches have selected the species that are adapted to the 90-day growing season, soils, and to the available water supply.

Table 1-1 Big Sandy Salinity Study Water Budget, 1960-1977, Big Sandy River Unit Salinity Study, Wyoming

Year	Water Losses From Irrigation System				Change in Reservoir Storage 1/		Water Budget - Unaccountable Water 2/	
	Crop Consumptive Use	Pheatophyte Use	Water Surface Evaporation	Total Losses	Gain to Storage	Loss to Storage	Loss into Irrigation System	Gain from Irrigation System
	acre-feet				(-)	(+)	(+)	(-)
1960	12,691	17,570	2,270	32,531	160			8,630
1961	14,160	15,960	2,400	32,520	530			6,040
1962	18,970	17,460	5,790	42,220	8,260		21,220	
1963	17,590	15,520	5,500	38,610	870		9,480	
1964	16,430	14,610	5,800	36,840		5,220	9,990	
1965	13,550	11,250	6,850	31,650	31,220		13,470	
1966	18,020	14,780	8,070	40,870		29,570	460	
1967	15,370	12,150	7,510	35,030	14,800		8,120	
1968	14,130	10,490	8,710	33,330	6,520		6,240	
1969	16,620	13,300	8,730	38,650		15,120	8,530	
1970	16,600	13,020	6,320	35,940		6,170		1,020
1971	17,030	11,650	6,890	35,570	11,740		8,800	
1972	19,590	14,010	8,320	41,920	3,610		4,470	
1973	18,570	14,670	8,390	41,630	4,820			3,630
1974	21,590	17,190	9,270	48,050		8,450		3,870
1975	18,480	14,420	8,040	40,940	3,870		3,020	
1976	17,720	14,310	8,760	40,790		2,130	4,110	
1977	13,860	12,230	5,010	31,100		15,530		12,130
(Average 1960-1977)	16,720	14,150	6,810	37,680	-230		3,470	

1/ Gain to storage would be a loss of water to the system for that year.

2/ Basic budget shows approximately 3,470 acre-feet per year of unaccountable water going into the irrigation system annually.

BIG SANDY RIVER UNIT SALINITY STUDY

SCHEMATIC WATER BUDGET

Average Annual Volumes
(Acre-feet)
1960 - 1977 Period

FIGURE 1-1

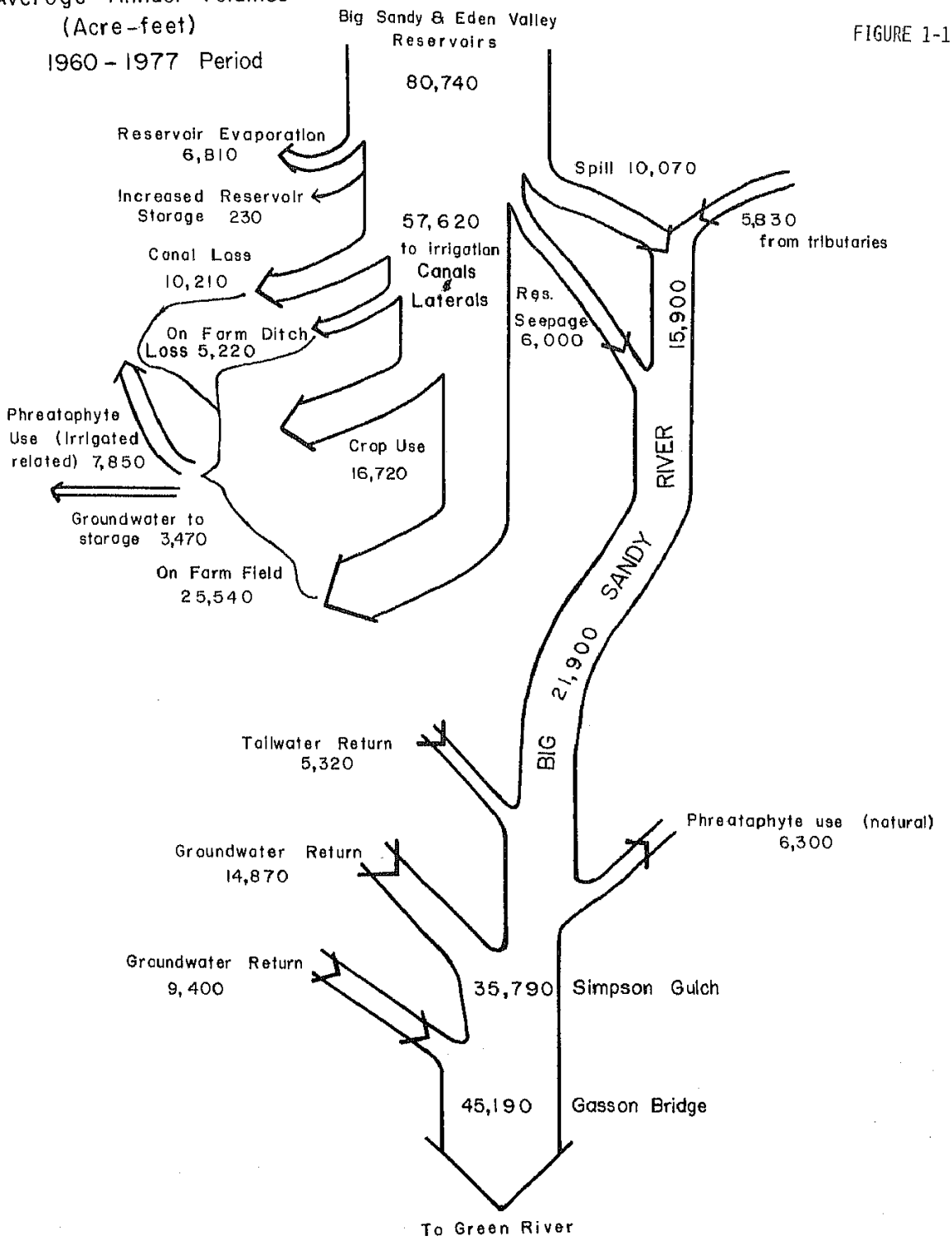

Table 1-2 Salt Load Analysis 1960-1977 -- Big Sandy River Unit Salinity Study, Wyoming

Year	Water 1/ Volume at Gasson Bridge	Water Volume at Simpson Gulch	Difference In Volume	Tons 2/ of Salt (7.96)	Tons of Salt at Simpson Gulch	Tons of Salt at Gasson Bridge
	(Acre-Feet)				(Tons)	
1960	16,990	11,145	5,845	46,530	37,800	84,330
1961	13,010	8,202	4,878	38,830	27,900	66,730
1962	35,520	26,516	9,004	71,670	52,500	124,170
1963	24,160	16,862	7,298	58,090	57,800	115,890
1964	26,940	19,159	7,781	61,940	58,700	120,640
1965	45,940	35,879	10,061	80,090	72,700	152,790
1966	49,280	38,960	10,320	82,150	75,100	157,250
1967	60,570	49,645	10,925	86,960	77,700	164,660
1968	49,640	39,290	10,350	82,390	78,600	160,990
1969	72,070	60,890	11,180	88,990	87,200	176,190
1970	30,580	22,240	8,340	66,390	68,300	134,690
1971	41,980	32,270	9,710	77,290	75,300	152,590
1972	76,110	64,970	11,140*		92,500	182,400
1973	58,170	46,690	11,480*		100,600	197,700
1974	65,850	54,350	11,500*		100,800	194,900
1975	57,910	47,820	10,090*		98,500	179,800
1976	54,400	44,060	10,340*		105,700	176,300
1977	34,150	25,280	8,870*		70,640	143,240
TOTAL					1,338,340	2,685,260
AVERAGE ANNUAL					74,350	149,180

1/ Computed from volume at Gasson Bridge = 6.1045 x (Volume at Simpson Gulch)$^{.85109}$ (for 1960-1971), measured flow 1972 through 1977.

2/ Mean annual salt concentration gain between Simpson Gulch and Gasson Bridge for the period of 1972-1977. The salt gain water factor is estimated at 7.96 tons per acre-foot.

*/ Measured change from gages.

Table 1-3 Irrigation Water Budget for Eden Valley Irrigation Project for 1960-1977, Big Sandy River Unit Salinity Study, Wyoming

Watershed Yield	Reservoir Evaporation	Total Water Diverted to Canals and Laterals	Average Irrigated Acreage	Canal and Lateral Losses	Farm Delivery	On-Farm Ditch Loss	Crop Irrigation Use	On-Farm Irrigation Efficiency	Total Diversion Irrigation Efficiency
(Acre-Feet)				(Acre-Feet)				(Percent)	
86,570	6,810	57,620	14,320	10,210	47,440	5,220	16,720	35	29

Table 1-4 Present Land Use Distribution
Eden Valley Irrigation Project - 1979
Big Sandy River Unit Salinity Study, Wyoming

Land Use	Acres	Percent
Border Irrigated	11,100	70.7
Oats	700	
Alfalfa Establishment	700	
Alfalfa	4,800	
Tame Hay	4,900	
Sprinkler Irrigated	600	3.8
Oats	60	
Alfalfa Establishment	60	
Alfalfa	480	
Sub-Irrigated	1,500	9.6
Oats	100	
Alfalfa Establishment	100	
Alfalfa	600	
Tame Hay	400	
Pasture	300	
Combined Border-Sub-Irrigated	2,500	15.9
Oats	100	
Alfalfa Establishment	100	
Alfalfa	1,200	
Tame Hay	600	
Pasture	500	
TOTAL	15,700	100.0

Using the historic water supply and present 15,700 irrigated acres, the present on-farm efficiency is about 39 percent with a project efficiency of 32 percent. In addition, the water and salt budgets show that during the past few years salt contributions were greater than the 1960-1977 18-year average. Using the present irrigated acreage and a balanced water budget, the revised annual salt budget would produce a 157,600 ton output into the Big Sandy River. Under present conditions, it is estimated that 133,300 tons of salt are a result of irrigation and 24,300 tons are a result of runoff, erosion, and natural seeps.

If irrigation in the project area were completely eliminated, it is estimated that the contribution of salt from runoff, erosion, and natural seeps would increase to 32,700 tons. The increase, from 24,300 tons to 32,700 tons, is a result of lowering the water table, allowing the natural interaction of the river and the aquifer flow to occur.

Improved water management is needed throughout the irrigation conveyance, distribution, and application systems. Emphasis would be directed toward diverting the correct amount of water for plant requirements and avoiding seepage and resulting deep percolation losses. Because salt pickup to the Big Sandy River is from the underlying soluble sediments, the overall system analysis for improvement would be geared to efforts toward reducing deep percolation and return flow to the stream system.

Diffused Area Watershed Management

The evaluation indicates that contribution of salt to the Colorado River system by the range areas above the irrigated cropland is generally low. Since only minimal salinity reduction benefits from improving range areas could be expected, no treatment measures have been proposed for this area.

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CHAPTER 2

PROGRAM DEVELOPMENT AND STUDY PARTICIPATION

Colorado River Water Quality Improvement Program

Recognition of the potential water quality problems in the Colorado River Basin was made as early as 1903, with the initial work to identify allowable salinity levels for maintenance of crop production under irrigation. At that time a limited amount of water sampling and analyses were being performed, primarily by the Geological Survey. The main purpose of the early tests was to evaluate the suitability of the water supply for irrigation and other uses. In time, it became quite clear that a gradual increase in salinity had taken place as a result of water resource development.

Salt concentrating effects are produced by evaporation, transpiration, and diversion of high quality water out of the basin. Also, salt loading effects occurred through the addition of dissolved solids to the river system from both natural and manmade sources. Because of the wide fluctuations in concentration from natural causes, the developments on the river, particularly the larger reservoirs, produced offsetting beneficial effects by stabilizing the quality of water.

Prior to the authorization of the Colorado River Storage Project and participating projects, it was evident that these major actions would result in increased consumptive use of the water both within and outside the Colorado River Basin. With this added use of water significant increases in salinity levels could be expected. Congress directed that specific studies be made of the water quality problem and that control plans be developed in deference to the concern of the people of the Basin and the users of the Colorado River water.

As a result of the Congressional requirements, a basic network of water quality stations were established at principal points throughout the Colorado River Basin. Analyses and studies were begun for the entire Basin. Biennial reports were started in 1963, and have continued since that time. The Colorado River Basin Water Quality Control Project was established in 1960 by the U. S. Public Health Service. The project functions were later transferred to the Federal Water Quality Administration (FWQA) within the Department of the Interior and, subsequently, transferred to the Environmental Protection Agency (EPA). The early project investigations assisted in identifying many of the water quality problems of the Basin. In 1963 efforts were directed toward evaluating salinity problems.

In 1968 the FWQA and the Bureau of Reclamation (USBR) initiated a joint reconnaissance salinity control study in the Upper Basin to identify potential controllable sources of salinity, make preliminary assessments of the technical feasibility of the control measures, and derive initial cost estimates for installation and operation of such

measures. Also in 1968, the two agencies cooperated to develop a proposed salinity control plan of study for the entire Colorado River Basin. With the Federal reorganization activities which transferred the responsibilities of FWQA to the newly established EPA, the program became inactive.

Subsequently, the Colorado River Board of California undertook studies of the salinity problem and issued a report in 1970 entitled "Need for Controlling the Salinity of the Colorado River." The EPA completed a report on the studies. It was this report entitled "The Mineral Quality Problems in the Colorado River Basin," dated 1971, which set the stage for the enforcement conference. Under the direction of the Water Resources Council, a State-Federal interagency group prepared a framework program for the development and management of the water and related land resources of the Lower Colorado Region. This report recognized the salinity problem in the Basin and recommended continuing studies of the Region's increasingly complex water quality problems. Concurrently, the Water and Power Resources Service (WPRS), with the assistance of the several States involved, developed a program for investigating methods of controlling the salinity of the river.

In 1972, the United States entered into an agreement with Mexico (Minute Number 242). Minute Number 242 contains the following provision ". . . the United States shall adopt measures to assure that by no later than July 1, 1974, the water delivered to Mexico upstream from Morelos Dam will have an average annual salinity of not more than 115 ppm, plus or minus 30 ppm, over the annual average salinity at Imperial Dam".

As a result of Minute Number 242, Congress enacted the Colorado River Basin Salinity Control Act (Public Law 93-320) on June 24, 1974. Public Law 93-320 consists of two parts: Title I, which deals basically with salinity control from the Wellton-Mohawk Irrigation and Drainage District in Arizona, and other activities below Imperial Dam; and Title II, which directs the Secretary of the Interior to implement a basinwide salinity control program. Title II includes authorization for the implementation of four salinity control units and directs that planning be undertaken for twelve other units. The Big Sandy River Unit is one of the twelve named to be investigated and planned for salinity reduction to the Colorado River.

The Soil Conservation Service (SCS), the Science and Education Administration, and the Agricultural Stabilization and Conservation Service have been participating in implementing Title II of the Act. A Memorandum of Understanding setting forth cooperation between USDA and the Department of the Interior has been executed, as well as a specific Memorandum of Agreement between SCS and USBR for specific Title II activities under the Act.

A final program environmental impact statement (EIS) was prepared for the Colorado River Water Quality Improvement Program by the USBR and the SCS in support of Title II of the Act. A draft EIS was made available to the Council on Environmental Quality (CEQ) and the public on March 5, 1976. The final program EIS was filed with CEQ on May 19, 1977.

Big Sandy River Unit Interdisciplinary Study Team

Coordination of USDA activities was accomplished through an Interdisciplinary Study Team. This team consisted of members from the SCS State Office Staff in Casper; SCS Rock Springs Field Office; and the SCS Western Wyoming RC&D Project Office. Local members were named from the Big Sandy Conservation District and the Eden Valley Irrigation and Drainage District. State and other federal agencies that assisted included the Wyoming State Engineer's office; Wyoming Department of Agriculture and Conservation Commission; University of Wyoming; Wyoming Game and Fish Department; Fish and Wildlife Service; WPRS; Bureau of Land Management; Economics, Statistics, and Cooperatives Service; Science and Education Administration; and the Forest Service. Approximately 14 coordination and information meetings were held with state and federal agencies between February 1977 and April 1979.

Local Coordinating Committee

A Local Coordinating Committee, whose representation includes two board members of the Eden Valley Irrigation and Drainage District, the board of supervisors for the Big Sandy Conservation District consisting of five members, a member of the State Engineer's staff appointed by the Governor's office, a representative from the WPRS, and SCS personnel, took an active part in the development and review of the salinity reduction alternatives. During the course of the study numerous meetings were held with the Local Coordinating Committee to review the progress of the study and provide guidelines and inputs. Various alternatives for salinity reduction were suggested by the Committee, which were analyzed and presented.

Public Meetings

Three public meetings were held for the purpose of providing information, review of alternatives and soliciting comments or suggestions. The initial public information meeting was held at Farson, Wyoming on March 24, 1977, to give an overview of the Big Sandy River Salinity Study. On March 8, 1979, a public meeting was held at the Farson School at which results of the study were presented, outlining 11 alternatives for salinity reduction. Because of comments received at this meeting the Local Coordinating Committee elected to send a summary of the various alternatives and a questionnaire to all the landowners in the valley. The questionnaire asked the landowners which alternative they would prefer to see implemented. Responses to the landowner questionnaire are shown in Appendix B, page B-1.

As a result of the responses to the questionnaire, two additional alternatives were analyzed. A third public meeting was held on April 23, 1979, at which the results of the landowner questionnaire were discussed. The two additional alternatives were presented and previous alternatives were reviewed. In response to discussion at this meeting a Landowner Preferred-Modified Alternative (Alternative 12) was selected as preferred and has been used for comparison of impacts against the NED and EQ alternatives (See Figure 3-5).

The Wyoming Congressional Delegation sent a personal letter to each landowner in which was stated, "We are following the matter closely and when the Secretary's recommendations come to Congress, we will be in a position to express your thoughts and concerns on this matter". (See letter dated May 23, 1979 in Chapter 5.)

Interagency Archeological and Fish and Wildlife Coordination

The Wyoming State Archeological and Historic Preservation Officer has been notified of the salinity study, along with proposed structural measures which may result from the salinity reduction alternatives. Consultation has also been held with the Fish and Wildlife Service and the Wyoming Game and Fish Department concerning endangered and threatened species for the project area, along with several meetings for development of wildlife mitigation plans.

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CHAPTER 3

ALTERNATIVES AND THEIR IMPACTS

This chapter presents alternatives considered to reduce salt loading problems identified in Chapter 2. Alternatives 1 through 13 are briefly described in this chapter. The alternatives provide a wide range of potential actions and evaluations from no project action to increased on-farm irrigation efficiency to irrigation or land retirement. An economic display was prepared to show the relationship between itemized benefits and cost of each alternative. It should be noted that Alternative 7, set up to be "partial land retirement", was not evaluated because of similarity to Alternative 11.

The economic impacts (benefits) for each milligram per liter change of salt concentration at Imperial Dam on the Colorado River have been determined to be $416,000 per mg/l (1979 dollars). The source of this data is from Salinity Management options for the Colorado River--Damage Estimates and Control Program Impacts, June 1979, prepared by consortium of Water Resources Centers in the States of Arizona, California, Colorado, and Utah. This value comes from effects salinity has on public water supplies for municipal and agricultural uses in the Lower Colorado River. The 12,495 per mg/l (1979 dollars) value is based on agricultural, municipal, and industrial damage reduction at Green River, Wyoming. Other economic benefits come from increased crop production due to increased irrigation efficiencies.

The utilization of the rangeland within the Big Sandy River Unit associated with the Eden Valley Irrigation Project will not be effected by Alternatives 1, 2, 3, 3A, 3B, 4, 5, or 9. The present use of the rangeland is expected to continue. Alternatives 6, 8, 10, 11, 12, and 13 will affect rangeland and rangeland use. The effects on rangeland will be discussed in each of the appropriate alternatives.

In the display of impacts part of this chapter the NED, EQ and the Landowner Preferred-Modified Alternatives are presented and evaluated in detail. The NED Alternative is Alternative 8 and the EQ Alternative (Alternative 13) is a combination of Alternatives 4 and 10.

Alternatives Considered to Reduce Salt Loading Problems

Alternative 1 - Future Without a Project--No Action

This alternative was prepared to develop a base for the study. It shows that irrigated agriculture can be expected to net an average income of about $47.00 per acre per year. The present average on-farm irrigation efficiency of 39 percent and an overall project efficiency of 32 percent would be expected to continue. Present salt delivery to the Big Sandy River is estimated at 157,600 tons per year, of which 133,300 tons are the result of irrigation.

It is anticipated that the future without a project condition will be the same as the present condition. Therefore, project irrigation efficiencies and salt contributions are projected to continue in the future as they presently occur.

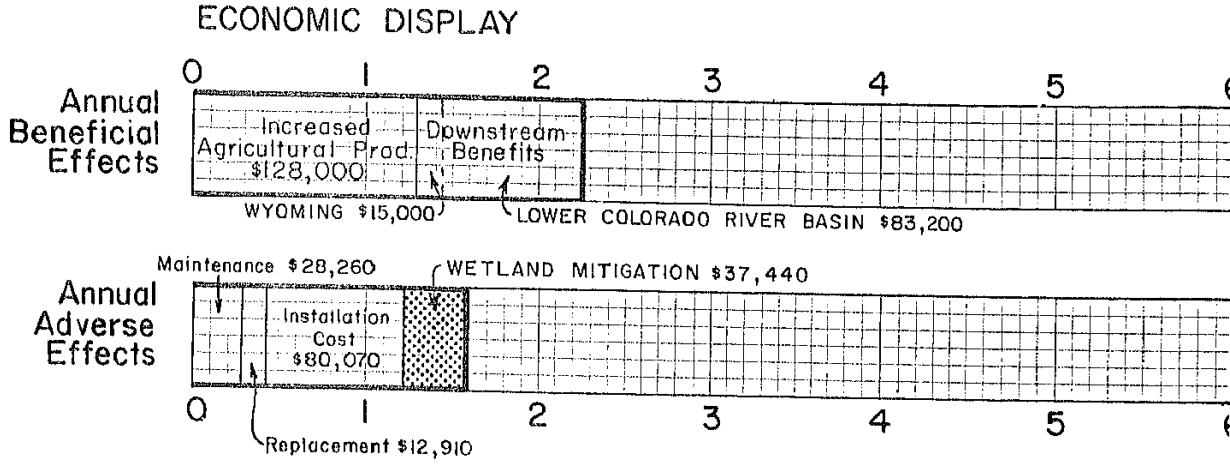
Alternative 2 - Minimal Structural Improvements

This alternative consists of cleaning out farm head ditches so that they will have the capacity to carry a flow of six cfs. In addition, concrete turnout gates would be installed on approximately 40 percent of the project area. The remaining project lands (60 percent) have existing improved turnout gates. To improve efficiency and on-farm irrigation water management, 2,500 acres of land will be leveled.

Mitigation to lessen overall adverse environmental impacts of this alternative would include installing wetland enhancement measures (water supply, nesting structures, nesting islands, excavated potholes, fences) on 180 acres of existing wetlands. A total of 90 acres of adjacent terrestrial habitat would be acquired and added to the wetland areas, to be managed as public land. Existing wetlands are Types 3 and 4, with an average size of 30 acres. Water not diverted to the farmland because of improved irrigation efficiency, would be stored in the existing reservoirs for use during water short years and to add to the existing fisheries pool during excess water supply years.

On-farm irrigation efficiencies would increase from an average of 39 percent to 41 percent, and project efficiency from 32 percent to 34 percent. Salt loading to the Green River would be reduced from 157,600 tons per year to 154,900 tons per year. Total dissolved solids would be reduced by .20 mg/l at Imperial Dam, and 1.20 mg/l at Green River, Wyoming.

The following graph is an economic display of annual benefits and costs for Alternative 2.



Alternative 3 - Sprinkler Irrigation

This alternative would convert all the irrigated lands in the project area to a sprinkler irrigation system. A 6,400 H.P. pumping plant would be required to provide pressure to operate the sprinkler system. The entire distribution system would be through pipelines. Either siderolls or center pivot systems would be used.

It should be noted that during development of this alternative the first consideration was for a gravity pressure sprinkler irrigation system from the existing storage reservoir. It soon became apparent that there was insufficient head to operate the sprinklers. Therefore, a pumping plant was added to boost the existing pressure to make the sprinkler system operate efficiently.

Mitigation to lessen overall adverse environmental impacts of this alternative would include installing wetland enhancement measures (water supply, nesting structures, nesting islands, excavated potholes, and fences) on 862 acres of wetlands. A total of 430 acres of adjacent terrestrial lands would be acquired and added to the wetland areas to be managed as public lands. Existing wetlands include: 180 acres of Types 3 and 4, averaging 30 acres in size, 177 acres of Type 11, averaging 4 acres in size, and 505 acres of Types 9 and 10, averaging 45 acres in size.

Water not diverted to the farmland because of improved irrigation efficiency, would remain in the existing reservoirs as carryover storage for irrigation use, during water short years. Excess water in the

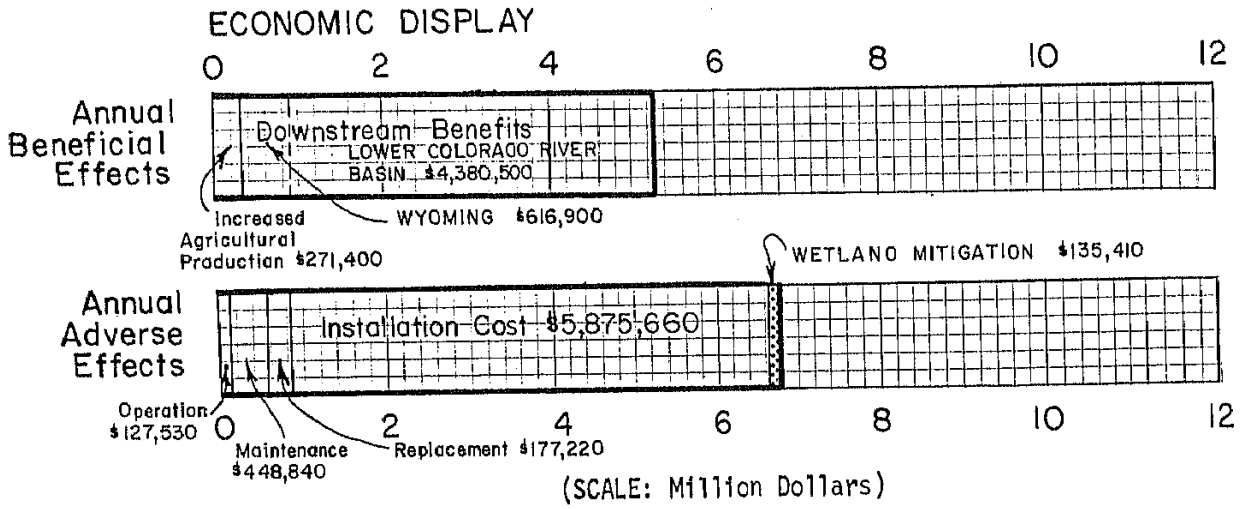
reservoirs would be released on a schedule proposed by FWS, WGF, and SCS to enhance fish habitat and reduce downstream flood damages. The following schedule is an example of how the excess water could be released during an average water year.

May through November 24 - 25 cfs
November 25 through April 20 - 15 cfs
April 21 through April 30 (10 days) - 186 cfs

On-farm irrigation efficiencies would increase from an average of 39 percent to 68 percent, and project efficiency from 32 percent to 68 percent. Salt loading in the Colorado River would be reduced from an average of 157,600 tons per year to 61,300 tons per year. Total dissolved solids would be reduced by 10.53 mg/l at Imperial Dam, and 49.37 mg/l at Green River, Wyoming.

This alternative was presented at the public meeting, recognizing that the average annual cost to provide the irrigation improvements, including operation, maintenance, and replacement costs exceed the average annual benefits.

The following graph is an economic display of annual benefits and costs for Alternative 3.



Alternative 3A - Sprinkler Irrigation

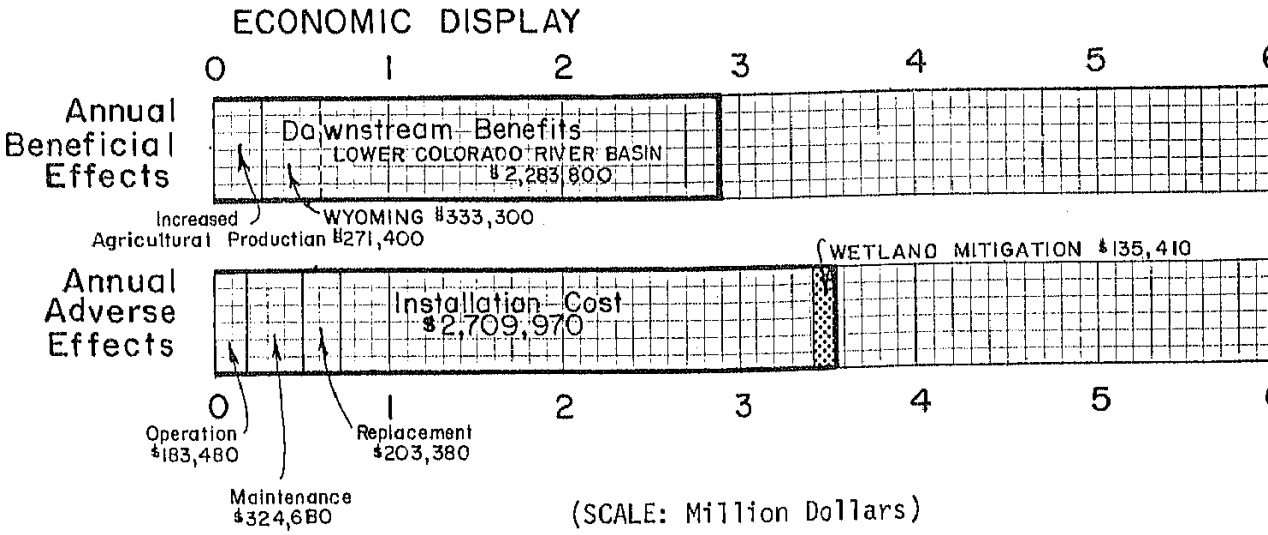
This alternative would convert all the irrigated lands in the project area to sprinkler irrigation. Either siderolls or center pivots would be used. The major canals and most of the laterals would remain unchanged. Six pumping plants would provide the pressure for sprinkler irrigation to groups of farms.

The mitigation measures for this alternative are the same as those shown for Alternative 3.

On-farm irrigation efficiencies would increase from an average of 39 percent to 68 percent, and project efficiency from 32 percent to 50 percent. Salt loading in the Colorado River would be reduced from an average of 157,600 tons per year to 104,700 tons per year. Total dissolved solids would be reduced by 5.49 mg/l at Imperial Dam, and 26.67 mg/l at Green River, Wyoming.

This alternative was presented at the public meeting, recognizing that the average annual cost to provide the irrigation improvements, including operation, maintenance, and replacement costs exceed the average annual benefits.

The following graph is an economic display of annual benefits and costs for Alternative 3A.



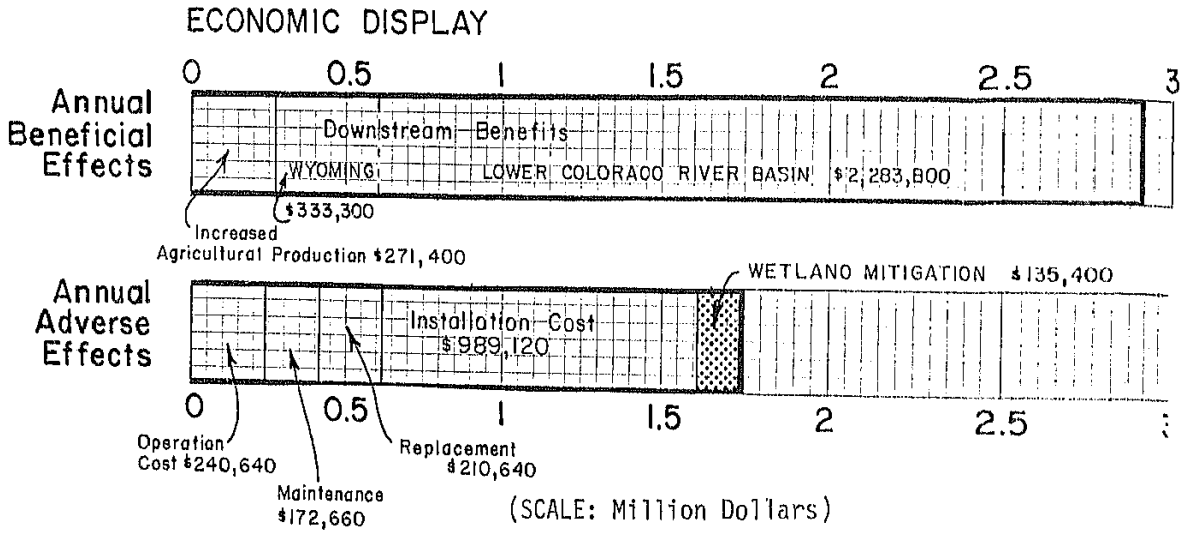
Alternative 3B - Sprinkler Irrigation

This alternative consists of sprinkler irrigation throughout the entire project area. Each farm would have an individual pumping plant, located at the present farm headgate. An on-farm distribution pipeline would replace existing open ditches. The type of sprinkler system would be optional (sideroll, center pivot, etc.). This alternative would require a water wasteway system to be used should there be power failure.

The mitigation measure for this alternative are the same as those shown for Alternative 3.

On-farm irrigation efficiencies would increase from an average of 39 percent to 68 percent, and project efficiency from 32 percent to 50 percent. Salt loading in the Colorado River would be reduced from an average of 157,600 tons per year to 104,700 tons per year. Total dissolved solids would be reduced by 5.49 mg/l at Imperial Dam, and 26.67 mg/l at Green River, Wyoming.

The following graph is an economic display of annual benefits and costs for Alternative 3B.



Alternative 4 - Automated Border Irrigation

This alternative consists of lining all on-farm irrigation ditches. Existing farm border systems would be used and semi-automated or automated gates and controls would be used to turn the water from border to border. A total of 1,500 acres would be sprinkler irrigated by individual farm pumping plants and 5,000 acres of land leveling would be included.

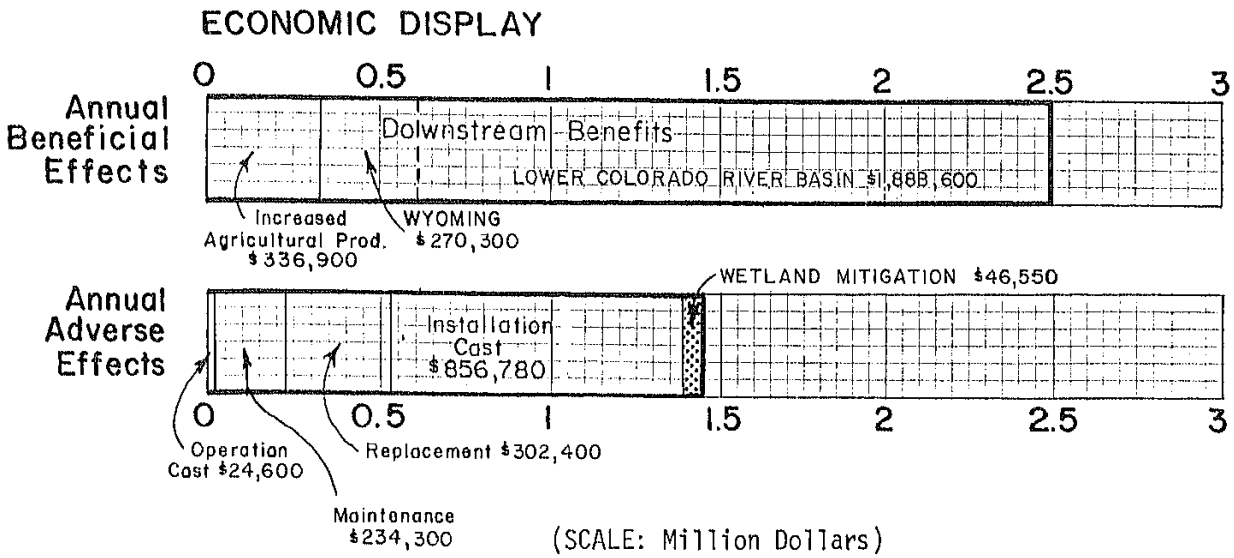
Mitigation to lessen overall adverse environmental impacts of this alternative would include installing wetland enhancement measures (water supply, nesting structures, nesting islands, excavated potholes, fences) on 180 acres of existing wetlands. A total of 90 acres of adjacent terrestrial land would be acquired and added to the wetland areas, to be managed as public land. Existing wetlands include 180 acres of Types 3 and 4, averaging 30 acres in size.

Water not diverted to the farmland because of improved irrigation efficiency would remain in the existing irrigation reservoirs for use during water short years. Excess water in the reservoirs would be released on a schedule proposed by FWS, WGF, and SCS to enhance fish habitat and at the same time reduce downstream flood damages. The following schedule is an example of how the excess water could be released during an average water year.

May through November 24 - 25 cfs
November 25 through April 20 - 15 cfs
April 21 through April 30 (10 days) - 186 cfs

On-farm irrigation efficiencies would increase from an average of 39 percent to 62 percent, and project efficiency from 32 percent to 46 percent. Salt loading in the Colorado River would be reduced from an average of 157,600 tons per year to 115,100 tons per year. Total dissolved solids would be reduced 4.54 mg/l at Imperial Dam, and 21.63 mg/l at Green River, Wyoming.

The following graph is an economic display of annual benefits and costs for Alternative 4.



Alternative 5 - Half of the Project Area Sprinkler Irrigated and Half Automated Border Irrigated

This alternative was developed to show a combination irrigation system approach. Structural features would be the same as that described in Alternatives 3B and 4.

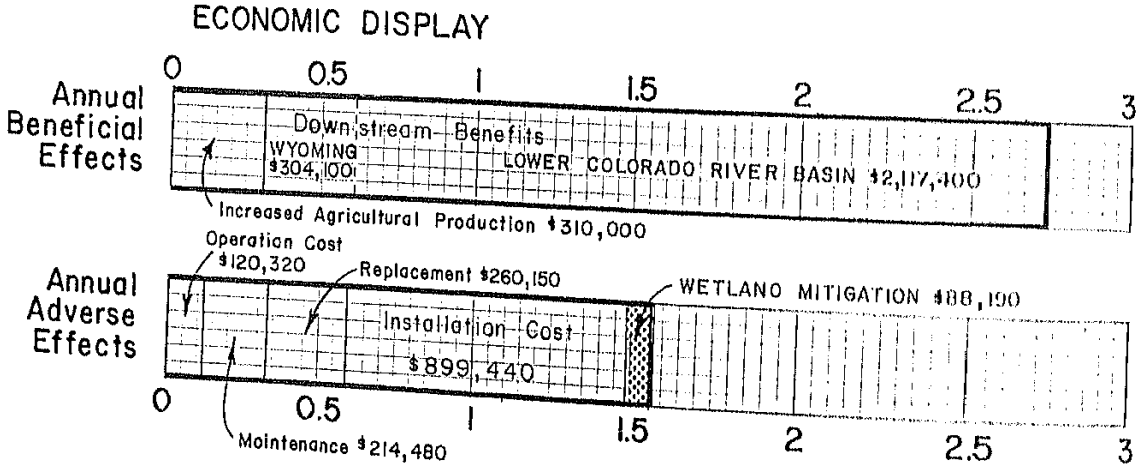
Mitigation to lessen overall adverse environmental impacts of this alternative would include installing wetland enhancement measures (water supply, nesting structures, nesting islands, excavated potholes, fences) on 357 acres of existing wetlands. A total of 175 acres of adjacent terrestrial land would be acquired and added to the wetland areas, to be managed as public land. Existing wetlands include: 180 acres of Types 3 and 4, averaging 30 acres in size, and 177 acres of Type 11, averaging 4 acres in size.

Water not diverted to the farmland because of improved irrigation efficiency would remain in the existing irrigation reservoirs for use during water short years. Excess water in the reservoir would be released on a schedule proposed by FWS, WGF, and SCS to enhance fish habitat and at the same time reduce downstream flood damages. The following schedule is an example of how the excess water could be released during an average water year.

May through November 24 - 25 cfs
November 25 through April 20 - 15 cfs April 21 through April 30 (10 days) - 186 cfs

On-farm irrigation efficiencies would increase from an average of 39 percent to 65 percent, and project efficiency from 32 percent to 48 percent. Salt loading in the Colorado River would be reduced from an average of 157,600 tons per year to 109,620 tons per year. Total dissolved solids would be reduced by 5.09 mg/l at Imperial Dam, and 24.34 mg/l at Green River, Wyoming.

The following graph is an economic display of annual benefits and costs for Alternative 5.



Alternative 6 - Land Retirement

This alternative would retire all the irrigated land. The existing irrigated land would revert back to improved rangeland. The landowner would be compensated for loss of irrigated agricultural production by being paid a mutually agreeable value for land, equipment and buildings, farmhouse, appraisal expense, cost to retire project mortgage, and moving expenses.

Land retirement was evaluated assuming the ranchers and farmers moved from the land, which would then revert to native rangeland. Any rangeland presently utilized by ranchers or farmers would become available for use under the management of the appropriate government organization.

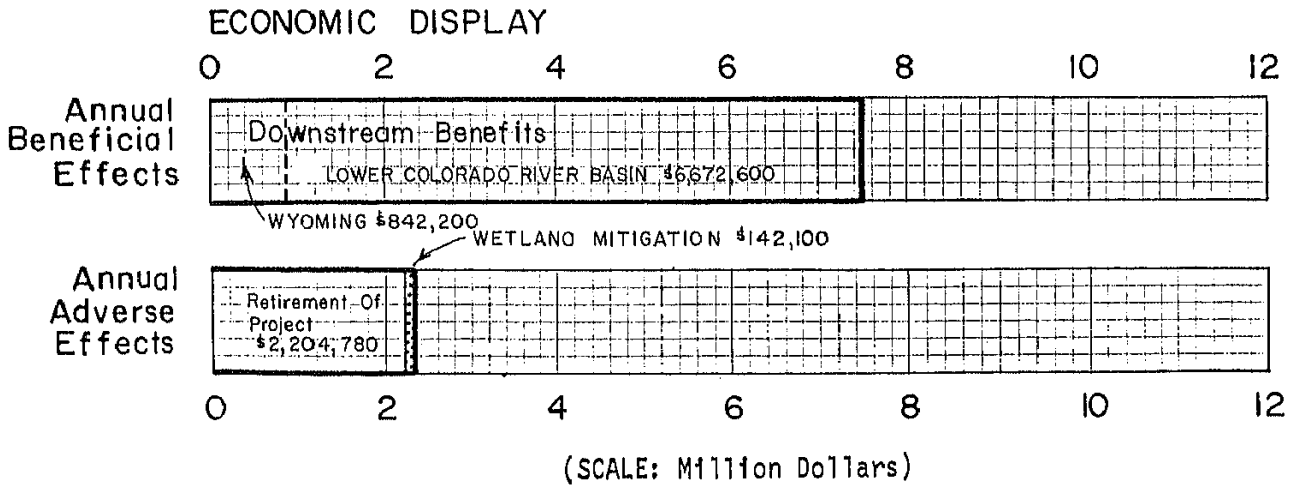
Mitigation to lessen overall adverse environmental impacts of this alternative would include installing wetland enhancement measures (water supply from artesian or pumped wells, nesting structures, nesting islands, excavated potholes, fences) on 862 acres of existing wetlands. A total of 420 acres of adjacent terrestrial land would be added to the wetland areas, to be managed as public land. Existing wetlands include: 180 acres of Types 3 and 4, averaging 30 acres in size, 177 acres of Type 11, averaging 4 acres in size, and 505 acres of Types 9 and 10, averaging 45 acres in size.

Water from Big Sandy River and Little Sandy Creek stored in the existing reservoirs would be under the Wyoming State Engineer's jurisdiction. Any release schedule of the water from the reservoirs to enhance fish habitat and/or to reduce downstream flood damage would be made with the State Engineer on a year by year basis. The following schedule proposed by FWS, WGF, and SCS is an example of how the excess water (if not appropriated to another use) could be released during an average water year.

May through November - 60 cfs
November 25 through April 15 - 25 cfs
April 15 through April 30 - 186 cfs

Salt loading in the Colorado River would be reduced from an average of 157,600 tons per year to 32,700 tons per year. Total dissolved solids would be reduced by 16.04 mg/l at Imperial Dam, and 67.4 mg/l at Green River, Wyoming.

The following graph is an economic display of annual benefits and costs for Alternative 6.



Land retirement was evaluated assuming the ranchers and farmers moved from the land, which would then revert to native rangeland. Any rangeland presently utilized by ranchers or farmers would become available for use under the management of the appropriate government organization.

Mitigation to lessen overall adverse environmental impacts of this alternative would include installing wetland enhancement measures (water supply from artesian or pumped wells, nesting structures, nesting islands, excavated potholes, fences) on 862 acres of existing wetlands. A total of 420 acres of adjacent terrestrial land would be added to the wetland areas, to be managed as public land. Existing wetlands include: 180 acres of Types 3 and 4, averaging 30 acres in size, 177 acres of Type 11, averaging 4 acres in size, and 505 acres of Types 9 and 10, averaging 45 acres in size.

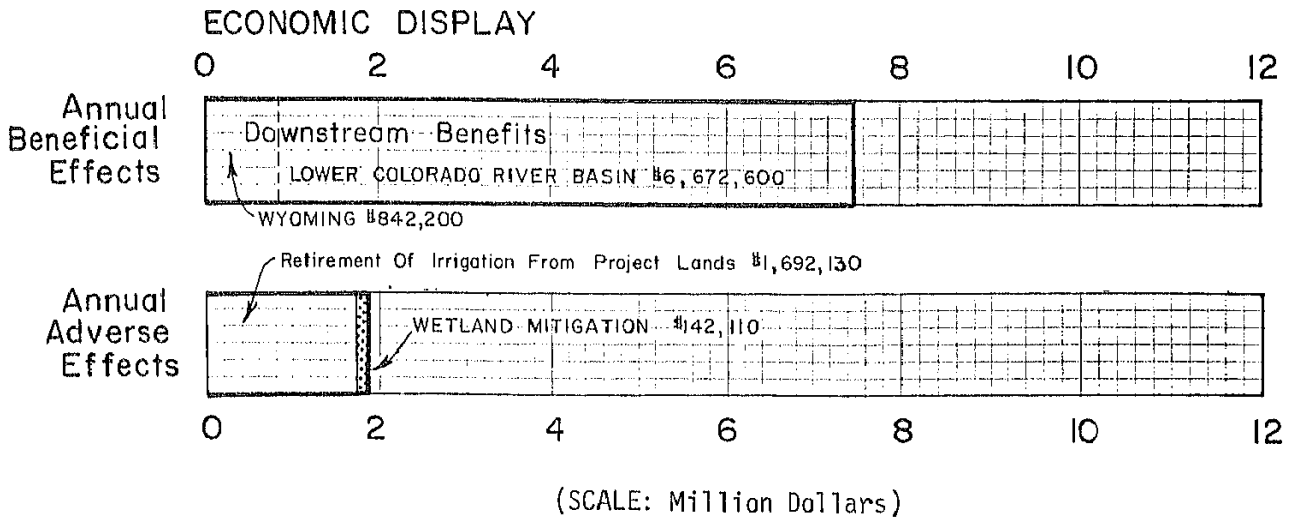
Water from Big Sandy River and Little Sandy Creek stored in the existing reservoirs would be under the Wyoming State Engineer's jurisdiction. Any release schedule of the water from the reservoirs to enhance fish habitat and/or to reduce downstream flood damage would be made with the State Engineer on a year by year basis. The following schedule proposed by FWS, WGF, and SCS is an example of how the excess water (if not appropriated to another use) could be released during an average water year.

May through November - 60 cfs
November 25 through April 15 - 25 cfs
April 15 through April 30 - 186 cfs

Salt loading in the Colorado River would be reduced from an average of 157,600 tons per year to 32,700 tons per year. Total dissolved solids would be reduced by 16.04 mg/l at Imperial Dam, and 67.4 mg/l at Green River, Wyoming.

The following graph is an economic display of annual benefits and costs for Alternative 6.

The following graph is an economic display of annual benefits and costs for Alternative 8.



Alternative 9 - Irrigation Water Reduction

This alternative would limit the landowner to approximately 2.0 acre-feet of water per acre per year. The landowner would sign an agreement to reduce water use to the specified amount. If the landowner with the reduced water supply irrigated his total acreage and produced a crop, negotiations would be made for full compensation. If the landowner used the reduced water supply to only irrigate a portion of his irrigated acreage, a reduced compensation would be made because more water would be going to deep percolation. This alternative would give the landowner various options to increase on-farm efficiency at his own discretion.

Mitigation to lessen overall adverse environmental impacts of this alternative would include installing wetland enhancement measures (water supply, nesting structures, nesting islands, excavated potholes, fences) on 180 acres of existing wetlands. A total of 90 acres of adjacent terrestrial land would be acquired and added to the wetland area, to be managed as public land. Existing wetlands include 180 acres of Type 3 and 4, averaging 30 acres in size.

Water not diverted to the farmland would remain in the existing irrigation reservoirs for use during water short years. Excess water in the reservoir would be released on a schedule proposed by FWS, WGF, and SCS to enhance fish habitat and at the same time reduce downstream flood damages. The following schedule is an example of how the excess

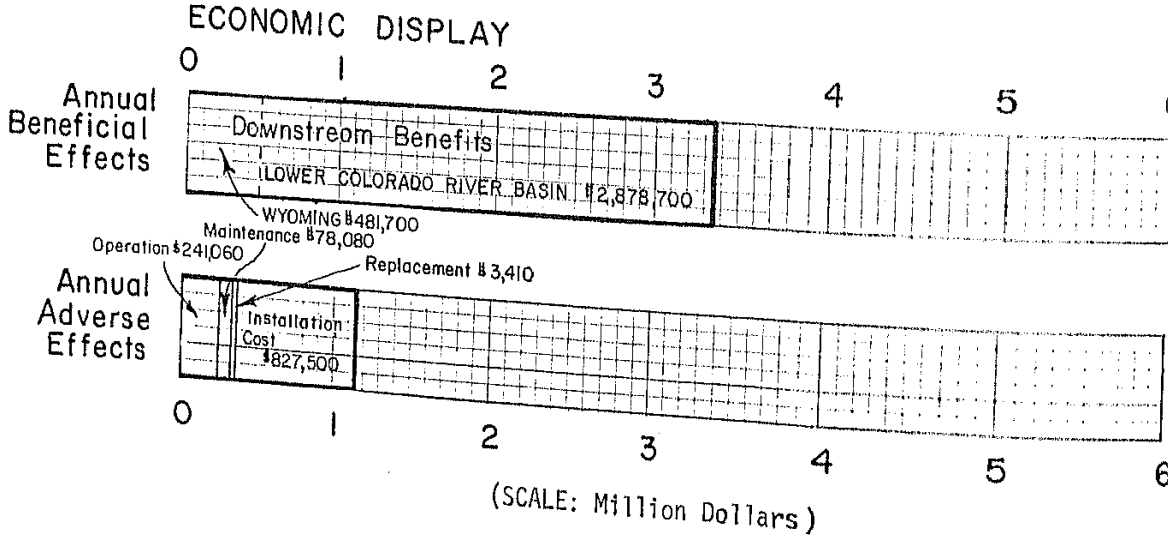
dam would be required to provide storage capacity of approximately 32,500 acre-feet. The dam would provide a reservoir or lake of about 8,000 surface acres. The resulting lake could be utilized as a waterfowl refuge. Preliminary soil testing in the proposed reservoir basin indicates the soils to have a very low permeability. The reservoir basin would become increasingly tighter as the soils are exposed to the saline water and lining would not be required. Technical expertise needed to design this waterfowl development can be provided by the U. S. Fish and Wildlife Service and the State of Wyoming.

The proposed Sublettes Flat Reservoir and Waterfowl Refuge would not effect the 15,700 acres of irrigated land nor the associated rangeland utilized with it. However, the 8,000 acres needed for the dam and reservoir site would reduce the rangeland acres by that amount. The reservoir site is in public ownership and is being managed by the Bureau of Land Management.

This alternative could be used at a lesser size and in conjunction with any of the other alternatives presented. All alternatives presented, with the exception of Alternative 1 and this alternative, have plans for mitigation to lessen the overall impact of wetland losses within the farming area. These plans include installation of various items to save, maintain, and enhance some of the more important wetlands that would be lost if water tables were lowered as a result of less water applied to the farms. Installation of Sublettes Flat Reservoir would create many times over the amount of wetland habitat lost while reducing salt loading to the Big Sandy River.

This alternative was evaluated with the present condition of irrigation. Salt loading in the Colorado River would be reduced from an average of 157,600 tons per year to 76,300 tons per year. Total dissolved solids would be reduced by 6.92 mg/l at Imperial Dam, and 38.55 mg/l at Green River, Wyoming.

The following graph is an economic display of annual benefits and costs for Alternative 10.



Alternative 11 - Landowner Preferred

This alternative would retire from irrigation 13,700 acres of farmland of which approximately 12 percent would sell their property and move and 88 percent would retain ownership of land and discontinue irrigation. The existing canal and lateral system would provide water to irrigate the remaining 2,000 acres. Of the 2,000 acres, 90 acres would have no structural improvements 420 acres would have minimal structural improvements, 880 acres would have automatic border and sprinkler irrigation, and 610 acres would have a reduced water supply.

The "Landowner Preferred" alternative represents the questionnaire response of 56 percent of the landowners, covering 10,300 irrigated acres (66 percent). Projecting the questionnaire results to the total irrigated acreage indicates some 13,700 acres might retire from irrigation. The remaining 2,000 acres would continue to be irrigated. Thus, 13,700 acres would revert to rangeland use.

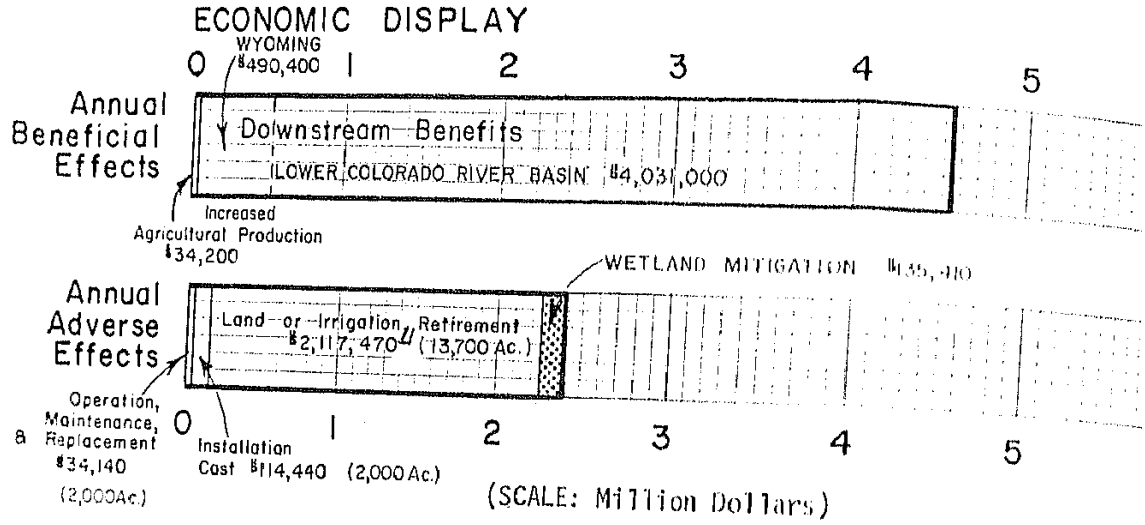
Mitigation to lessen overall adverse environmental impacts of this alternative would include installing wetland enhancement measures (water supply, nesting structures, nesting islands, excavated potholes, fences) on 862 acres of existing wetlands. A total of 430 acres of adjacent terrestrial land would be acquired and added to the wetland area, to be managed as public land. Existing wetlands include: 180 acres of Types 3 and 4, averaging 30 acres in size, 177 acres of Type 11, averaging 4 acres in size, and 505 acres of Types 9 and 10, averaging 45 acres in size.

Water not diverted to the farmland as a result of irrigation retirement would be stored in the existing reservoirs and would be under the Wyoming State Engineer's jurisdiction. Any release schedule of the water from the reservoirs to enhance fish habitat and/or to reduce downstream flood damage would be made with the State Engineer on a year by year basis. The following schedule proposed by FWS, WGF, and SCS is an example of how the excess water (if not appropriated to another use) could be released during an average water year.

May through November - 60 cfs
December through April 15 - 25 cfs
April 16 through April 30 - 186 cfs

On-farm irrigation efficiencies would be increased from an average of 39 percent to 56 percent. Overall project efficiency would decrease from 32 percent to 20 percent. The reduction of project efficiency is a result of the seepage losses that would be encountered in the canals and laterals during delivery of water to the remaining 2,000 acres. Salt loading in the Colorado River would be reduced from an average of 157,600 tons per year to 87,400 tons per year. Total dissolved solids would be reduced by 9.69 mg/l at Imperial Dam, and 39.25 mg/l at Green River, Wyoming.

The following graph is an economic display of annual benefits and costs for Alternative 11.



1/ Land or irrigation retirement costs computed at $2,000 per irrigated acre. This value was selected by the responding landowners as being the minimum they would sell their holdings for.

Alternative 12 - Landowner Preferred-Modified

This alternative would retire 13,700 acres of farmland from irrigation. Three pumping plants would be installed along the Big Sandy River and a distribution pipeline would deliver water to irrigate the remaining 2,000 acres. Of the 2,000 acres, 90 acres would have no structural improvements, 420 acres would have minimal structural improvements, 880 acres would have automatic border and sprinkler irrigation, and 610 acres would have a reduced water supply. The land use changes would be the same as Alternative 11, with some 13,700 acres reverting to rangeland use.

Mitigation to lessen overall adverse environmental impacts of this alternative would include installing wetland enhancement measures (water supply, nesting structures, nesting islands, excavated potholes, fences) on 862 acres of existing wetlands. A total of 430 acres of adjacent terrestrial land would be acquired and added to the wetland areas, to be managed as public land. Existing wetlands include: 180 acres of Types 3 and 4, averaging 30 acres in size, 177 acres of Type 11, averaging 4 acres in size, and 505 acres of Types 9 and 10, averaging 45 acres in size.

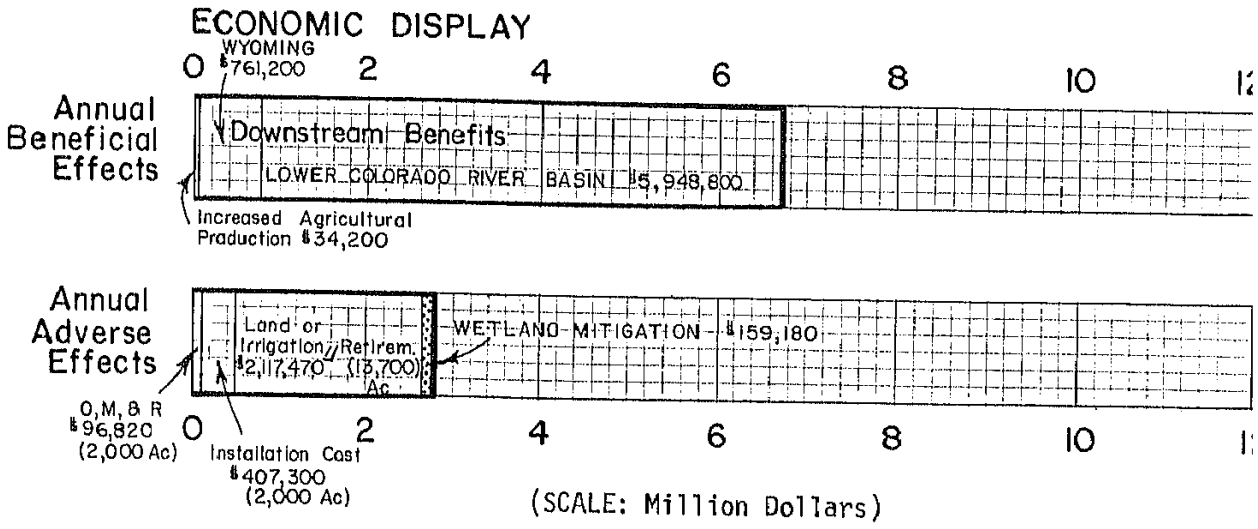
Water needed for irrigation would be released from the reservoir on a demand schedule. Water not required by the farmland as a result of irrigation retirement would be stored in the reservoirs and would be under the Wyoming State Engineer's jurisdiction. Any release schedule of the water from the reservoirs to enhance fish habitat and/or to

reduce downstream flood damage would be made with the State Engineer on a year by year basis. The following schedule proposed by FWS, WGF, and SCS is an example of how the excess water (if not appropriated to another use) could be released during an average water year.

May through November - 60 cfs
December through April 15 - 25 cfs
April 16 through April 30 - 186 cfs

On-farm irrigation efficiencies would increase from an average of 39 percent to 56 percent. Overall project efficiency would increase from 32 percent to 56 percent. Salt loading in the Colorado River would be reduced from an average of 157,600 tons per year to 44,230 tons per year. Total dissolved solids would be reduced by 14.30 mg/l at Imperial Dam, and 60.92 mg/l at Green River, Wyoming.

The following graph is an economic display of annual benefits and costs for Alternative 12.



1/ Land or irrigation retirement cost computed at $2,000 per irrigated acre. This value was selected by the reponding landowners as being the minimum they would sell their holdings for.

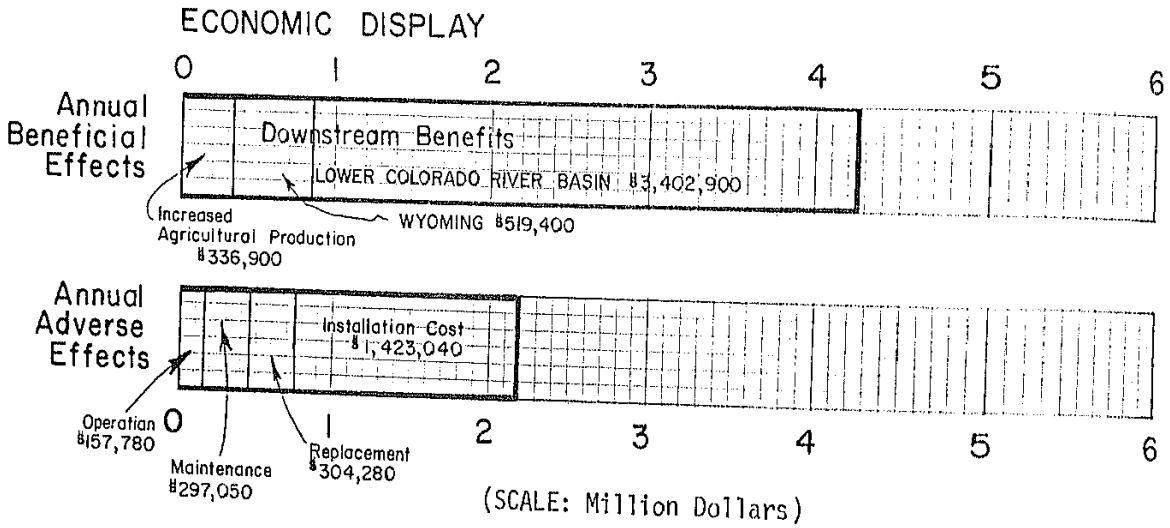
Alternative 13 (Environmental Quality)

This alternative is a combination of Alternative 4 (Automatic Border Irrigation) and a modified Alternative 10 (Pumping Saline Water to Sublettes Flat Reservoir). All irrigation improvement features of Alternative 4 are included. In addition, approximately 6,900 acre-feet of water would be pumped from wells drilled in the seep area to Sublettes Flat Reservoir for storage and evaporation. An approximate 13.5-foot high

dam would be required to provide the storage capacity. The dam would provide a reservoir or lake of about 4,100 surface acres. The resulting lake could be made into a waterfowl refuge, therefore a mitigation plan is not included in this alternative.

On-farm irrigation efficiencies would increase from an average of 39 percent to 62 percent. Overall project efficiency would increase from 32 percent to 46 percent. Salt loading in the Colorado River would be reduced from an average of 157,600 tons per year to 73,400 tons per year. Total dissolved solids would be reduced by 8.18 mg/l at Imperial Dam, and 41.57 mg/l at Green River, Wyoming.

The following graph is an economic display of annual benefits and costs for Alternative 13.



National Economic Development Alternative

This alternative is the same as Alternative 8, which would retire irrigation from the project area and mitigates the wetland losses. All irrigated land would revert back to improved rangeland. Landowners would remain on the farm and retain ownership of the land and all mineral rights. The landowner would be compensated for loss of irrigated agricultural production by being paid a mutually agreeable value for giving up water rights, improvements, irrigation, and that farm equipment used in the irrigation operations. Alternative 8 assumes that all landowners would have a livestock operation in the project area and would receive compensation to transport hay and develop stock water.

It should be noted that if the landowner does not have or want to retain a livestock operation, he would not be compensated for transportation of hay into the valley or for stock water development.

Refer to Alternative 8 for specific details.

Display of Impacts for NED, EQ, Landowner Preferred-Modified Alternatives

The beneficial and adverse effects of these three alternatives are estimated and displayed in the following figures. In order to describe expected impacts, the effects are evaluated from four viewpoints: (1) the national economy; (2) environmental quality; (3) the regional economy; and (4) social well-being.

Beneficial effects appearing in the National Economic Development (NED) account reflect increased production of goods, services and gains in production efficiency. They are presented on an average annual basis.

Adverse effects appearing in the NED account reflect the value of resources needed due to the plan element. The average annual costs in the accounts include, among other things, those for technical assistance, construction, operation, maintenance, replacement, and administration.

Beneficial effects appearing in the Environmental Quality (EQ) account reflect contributions resulting from the management, preservation, or restoration of the environmental characteristics of an area. Adverse effects reflect deterioration in these characteristics. Since the nature of an effect--whether it is adverse or beneficial--is often a personal judgment, no distinction is made on the nature of an effect in the EQ account.

The procedures for measuring beneficial and adverse effects in the Regional Development (RD) account are generally the same as those for the NED account. Also included are the federal and regional or local share of the costs.

Externalities were developed using multipliers from "Guideline 5 Regional Multipliers, January 1977", published by the Water Resource Council. The externalities used included both positive and negative effects within the region (Wyoming) and to the Lower Colorado River Basin.

Beneficial and adverse effects in the Social Well-Being account reflect impacts of an element on the amount and distribution of real income, of health and safety, and on educational, cultural, and social opportunities.

Figure 3-5, at the end of the chapter is a summary comparison of economic, environmental, regional, and social effects of the three following alternatives:

1 - National Economic Development (Irrigation Retirement Alternative 8)

2 - Landowner Preferred-Modified (Alternative 12)

3 - Environmental Quality (Alternative 13)

Similar four-account display of impacts for Alternatives 2, 3B, 4, 5, 6, 9, 10, and 11 are shown in Appendix C.

NATIONAL ECONOMIC DEVELOPMENT (NED)

IRRIGATION RETIREMENT (LIVESTOCK OPERATION)

FOUR ACCOUNT DISPLAY OF IMPACTS -- BIG SANDY RIVER UNIT SALINITY STUDY, WYOMING

ALTERNATIVE - B

NATIONAL ECONOMIC DEVELOPMENT ACCOUNT		ENVIRONMENTAL QUALITY ACCOUNT	
Components	Measure of Effects (Average Annual Dollars) 1/	Components	Measure of Effects
ADVERSE EFFECTS		BENEFICIAL AND ADVERSE EFFECTS	
A. Retirement of Irrigation Land From Project.		A. Quality consideration of water, land and air resources.	1. Reduce TDS by 67.4# mg/l in the Green River at Green River, and by 16.0# mg/l in the Colorado River at Imperial Dam, California. 2. Reduce Big Sandy River salt loading to the Green River from 157,600 tons annually to 32,700 tons. 3. Increase Big Sandy River streamflow 57,000 ac.ft. annually from reservoir to Eden Bridge.
1. Agricultural Production Loss ($10,616,000)	$ 781,340		
2. Transportation of hay into valley ($7,264,300)	534,650		
3. Livestock well development ($1,445,600)	106,400		
4. Buildings & Farm Equipment ($1,570,500)	115,590		
5. Cost to retire Reclamation Project Debt ($999,660)	73,570		
6. Project administration ($1,094,600)	80,580		
Subtotal	$1,692,130	B. Areas of natural beauty.	1. Change 14,000 ac. of bayland cover type to rangeland. 2. Improve visual quality of Big Sandy River from Big Sandy Dam downstream by increasing streamflow.
B. Wetland Mitigation			
1. Installation	$ 89,740		
2. Technical Assistance	12,470		
3. Operation, Maintenance, & Replacement	40,900	C. Biological resources and selected ecosystems.	1. Change 14,000 ac. of bayland cover type to rangeland. 2. Change 2,590 ac. of various woody ditch banks and border dikes to rangeland. 3. Dry up saline seeps or reduce flows to seeps below the Big Sandy Reservoir. 4. Provide additional water for instream fishery flows from Big Sandy Reservoir to Eden Bridge on release schedule recommended by the Wyoming Game & Fish Department. 5. Reduce water supplies to 1,010 wetland ac. and eliminate 2,765 wetland ac. of Types 1, 2, 6, 8, 9, 10, and 11. 6. Mitigate adverse effects on wetlands in #5 above by preserving and enhancing 462 wetland ac. of Types 3, 4, 5, and 10 and adding and enhancing 430 ac. of adjacent terrestrial habitat to wetland complexes. 7. Increase waterfowl breeding in wetland complexes.
Subtotal	$ 142,110		
TOTAL ADVERSE EFFECTS	$1,834,240	D. Irreversible or irretrievable commitments of resources.	1. Consume an undetermined amount of fossil fuels during construction and operation of project. 2. Commit labor for project operation and maintenance.
NET BENEFICIAL EFFECT	$5,630,560		

REGIONAL DEVELOPMENT ACCOUNT			SOCIAL WELL-BEING ACCOUNT	
Components	Measure of Effects State of Wyoming (Average Annual Dollars) 1/	Measure of Effects Rest of Nation	Components	Measure of Effects
(Table)				
ADVERSE EFFECTS 3/			BENEFICIAL AND ADVERSE EFFECTS	
A. The value of resources contributed within the region to achieve outputs.			A. Real income distribution	1. Create 53 work-years of jobs for area residents and 370 jobs in Lower Colorado Basin.
1. Single purpose salinity reduction.				2. Region income benefits of $2,971,730 will be distributed by income class as follows:
a. Project Installation	--	$ 1,611,550		
b. Wetland Mitigation Installation	--	88,740		
c. Wetland Mitigation OM&R	--	40,900		
2. Project administration and Technical Assistance	--	93,050		
B. The negative value of outputs to users residing in the region from monetary external diseconomies.				
1. Indirect activities associated with decrease net returns from agricultural production	$4,290,800	--		
Adverse Effects	$4,290,800	$1,834,240		
TOTAL COST		$6,125,040		
Net Beneficial Effects	$2,780,930	$23,241,760		

INCOME CLASS($)	% in INCOME CLASS	% BENEFITS in INCOME CLASS
Less than 5,000	17	10
5,000 to 15,000	71	60
More than 15,000	12	30

3. Region costs $4,290,600 will be borne by income class as follows:

INCOME CLASS($)	% in INCOME CLASS	% BENEFITS in INCOME CLASS
Less than 5,000	17	0
5,000 to 15,000	71	65
More than 15,000	12	35

Employment		
ADVERSE EFFECTS	WORK-YEARS	
A. Decrease in number and type of jobs.	4.00 Semiskilled	--
TOTAL ADVERSE EFFECTS	4.00 Semiskilled	--
NET BENEFICIAL EFFECTS	40.80 Semiskilled 4.37 Skilled	369.74 --

B. Life, health, safety

1. Improve waterfowl hunting.
2. Improve stream fishing.
3. Decrease mosquito breeding areas.
4. Agricultural production losses amount to $1,486,200 annually due to retirement of irrigation water.
5. Reduction in salt will decrease cost of water treatment while enhancing water quality.

NOTES:

1/ Land treatment benefits not evaluated.

2/ 50 years at 7 3/8 percent interest (0.07386).

3/ Source: Salinity Management Options for the Colorado River - damage estimates and control program impacts. June 1979. Consortium of Water Resources Centers in Arizona, California, Colorado, and Utah.

4/ Distribution by all factors. All benefits are derived from downstream salinity reduction.

FIGURE 3-3 ALTERNATIVE 12

LANDOWNER PREFERRED-MODIFIED

WATER DELIVERED TO AGRICULTURAL LAND BY PUMPS AND PIPELINES FROM THE RIVER

FOUR ACCOUNT DISPLAY OF IMPACTS -- BIG SANDY RIVER UNIT SALINITY STUDY, WYOMING

NATIONAL ECONOMIC DEVELOPMENT ACCOUNT

Components	Measure of Effects (Average Annual Dollars) 1/
BENEFICIAL EFFECTS	
A. The value of users of increased outputs of goods and services.	
1. Increased Agricultural Production Eden Valley	$ 34,200
2. Downstream Salinity Reduction	
a. State of Wyoming	761,200
b. Lower Colorado River Basin	5,948,800 2/
TOTAL BENEFICIAL EFFECTS	$6,744,200

Components	Measure of Effects (Average Annual Dollars) 1/
ADVERSE EFFECTS	
A. Irrigation	
1. Construction Cost ($4,664,500)	$ 358,030
2. Technical Assistance ($669,400)	49,270
3. Operation	22,300
4. Maintenance	54,970
5. Replacement	19,600
Subtotal	$ 504,170
B. Land or Irrigation Retirement	
1. Retirement Cost ($27,400,000)	$2,016,640
2. Administration ($1,370,000)	100,830
Subtotal	$2,117,470
C. Wetland Mitigation	
1. Installation ($1,216,780)	$ 89,550
2. Technical Assistance ($177,270)	13,050
3. Water Cost	13,320
4. Operation, Maintenance, & Replacement	43,260
Subtotal	$ 159,380
TOTAL ADVERSE EFFECTS	$2,700,820

NET BENEFICIAL EFFECT

$3,963,300

ENVIRONMENTAL QUALITY ACCOUNT

Components	Measure of Effects
BENEFICIAL AND ADVERSE EFFECTS	
A. Quality consideration of water, land and air resources.	1. Reduce TDS by 60.92 mg/l in the Green River at Green River, Wyoming and by 14.30 mg/l in the Colorado River at Imperial Dam, California. 2. Reduce Big Sandy River salt loading to the Green River from 157,600 tons annually to 44,230 tons. 3. Increase hayland production by an average of 0.478 tons/ac./yr. for 2,000 acres. 4. Conserve water by improving on-farm irrigation efficiency from 39% to 56% and project efficiency from 32% to 56% for 2,000 acres irrigated. 5. Increase Big Sandy River flow by 51,200 ac.ft./yr. from Big Sandy to Gassen Bridge.
B. Areas of natural beauty.	1. Change 12,285 ac. of hayland to range or pastureland. 2. Improve visual quality of Big Sandy River from Big Sandy Dam downstream by increasing streamflows.
C. Biological resources and selected ecosystems.	1. Change 12,285 ac. of hayland cover to range or pastureland. 2. Change 2,466 ac. of various weedy ditch banks and border dikes to rangeland. 3. Change 370 ac. remaining hayland irrigated by flooding to some other irrigation method. 4. Dry up saline seeps or reduce flows in seeps below the Big Sandy Reservoir. 5. Provide additional water for instream fishery flows from Big Sandy Reservoir to Gassen Bridge on release schedule recommended by the Wyoming Game & Fish Department. 6. Reduce water supplies to 1,010 wetland ac. and eliminate 2,765 wetland ac. of Types 1, 2, 3, 4, 9, 10, and 11. 7. Mitigate adverse effects on wetlands in #6 above by preserving and enhancing 862 wetland ac. of Types 3, 4, 10, and 11 and adding and enhancing 430 ac. of adjacent terrestrial habitat to wetland complexes.
D. Irreversible or irretrievable commitments of resources.	1. Consume and undetermined amount of fossil fuels during construction and operation of project. 2. Commit labor for project operation and maintenance.

REGIONAL DEVELOPMENT ACCOUNT

Components	Measure of Effects State of Wyoming (Average Annual Dollars) 1/	Measure of Effects Rest of Nation (Average Annual Dollars) 1/
Income		
BENEFICIAL EFFECTS		
A. The value of increased outputs of goods and services to users.		
1. Salinity reduction	$ 761,200 4/	$ 5,948,800 2/
2. Irrigation (2,000 acres)	43,260	- -
3. Additional wages and salaries accruing to the region from implementation of:		
a. Project OM&R	96,870	-96,870
b. Wetland Mitigation OM&R	43,260	-43,260
B. The value of outputs to users residing in the region from monetary external economies. 2/		
1. Indirect activities associated with increased net returns from irrigation and reduced damages from salinity reduction.	1,349,790	12,783,240
2. Returns due to change in employment.	1,033,200	- -
3. Reinvestment of capital received for irrigation retirement, maintaining livestock operations, land and farm improvements, etc.	4,209,180	- -
Beneficial Effects	$7,607,620	$18,591,910
TOTAL BENEFICIAL EFFECTS	$26,199,530	

Components	Measure of Effects State of Wyoming (Average Annual Dollars) 1/	Measure of Effects Rest of Nation (Average Annual Dollars) 1/
Costs		
ADVERSE EFFECTS 3/		
A. The value of resources contributed within the region to achieve outputs.		
1. Multipurpose salinity reduction and installation.		
a. Project installation	- -	$ 2,374,670
b. Wetland mitigation	- -	89,550
c. Project OM&R	- -	96,870
d. Wetland mitigation OM&R	- -	43,260
2. Project administration	- -	163,150
3. Wetland mitigation water costs	- -	13,320
B. The negative value of outputs of users residing in the region from monetary external diseconomies.		
1. Indirect activities associated with decreased net returns from agricultural production	$3,744,200	$ - -
2. Loss to region due to change in employment.	1,169,900	- -
Adverse Effects	$4,914,100	$2,780,820
TOTAL COST	$7,694,920	
Net Beneficial Effects	$2,693,520	$15,811,090

Employment:

	WORK-YEARS		
BENEFICIAL EFFECTS			
A. Increase in number and types of jobs.			
1. Employment for wetland mitigation	0.74	Semiskilled	- -
	2.02	Skilled	- -
2. Employment for project construction	2.25	Semiskilled	- -
	6.11	Skilled	- -
3. Employment for project OM&R	9.69	Semiskilled	- -
4. Employment for accelerated land treatment	0.45	Semiskilled	- -
	2.25	Skilled	- -
5. Indirect activity	26.98	Semiskilled	255.68
TOTAL BENEFICIAL EFFECTS	40.11	Semiskilled	255.68
	10.36	Skilled	- -

Employment:

	WORK-YEARS		
ADVERSE EFFECTS			
A. Decrease in number and type of job.			
1. Agricultural	9	Skilled	- -
NET BENEFICIAL EFFECTS	40.11	Semiskilled	255.68
	1.36	Skilled	- -

SOCIAL WELL-BEING ACCOUNT

Components	Measure of Effects
BENEFICIAL AND ADVERSE EFFECTS	
A. Real income distribution	1. Create 41 work-years of jobs for area residents and 256 jobs in Lower Colorado Basin. 2. Region income benefits of $7,607,620 will be distributed by income class as follows:

INCOME CLASS($)	% in INCOME CLASS	% BENEFITS in INCOME CLASS
Less than 5,000	17	10
5,000 to 15,000	71	60
More than 15,000	12	30

3. Region costs of $4,914,100 will be borne by income class as follows:

INCOME CLASS($)	% in INCOME CLASS	% BENEFITS in INCOME CLASS
Less than 5,000	17	0
5,000 to 15,000	71	65
More than 15,000	12	35

B. Life, health, safety	1. Improve waterfowl hunting. 2. Improve stream fishing. 3. Decrease mosquito breeding areas. 4. Increased output will be in livestock production. 5. Reduction in salt will decrease cost of water treatment while enhancing water quality. 6. Agricultural production losses amount to $1,296,900 annually due to retirement of irrigation water.

Note: Land treatment benefits evaluated. Land treatment costs are $62,320 (Technical Assistance).

1/ 50 years at 7 1/8 percent interest (0.07360). Price base 1979.

2/ Source: Salinity Management Options for the Colorado River - damage estimates and control program impacts. June 1979. Consortium of Water Resources Centers in Arizona, California, Colorado, and Utah.

3/ Project evaluation resulted in insufficient local benefits to handle normal cost-sharing or OM&R. Landowners would be unable to pay for local benefit accrual.

4/ Downstream in Wyoming.

ENVIRONMENTAL QUALITY

AUTOMATED BORDER AND SPRINKLER IRRIGATION (ALT. 4) AND SUBLETTES FLAT RESERVOIR (REDUCED ALT. 10)

FIGURE 3-4 ALTERNATIVE 13

FOUR ACCOUNT DISPLAY OF IMPACTS -- BIG SANDY RIVER UNIT SALINITY STUDY, WYOMING

NATIONAL ECONOMIC DEVELOPMENT ACCOUNT

Components	Measure of Effects (Average Annual Dollars) 1/
BENEFICIAL EFFECTS	
A. The value of users of increased outputs of goods and services.	
1. Increase Agricultural Production Eden Valley.	$ 336,900
2. Downstream Salinity Reduction	
a. State of Wyoming	819,400
b. Lower Colorado River Basin	3,402,900 2/
TOTAL BENEFICIAL EFFECTS	$4,259,200

Components	Measure of Effects (Average Annual Dollars) 1/
ADVERSE EFFECTS	
A. Irrigation	
1. Construction Cost ($10,070,000)	$ 741,800
2. Technical Assistance ($1,562,200)	114,980
3. Operation	24,600
4. Maintenance	234,300
5. Replacement	302,400
Subtotal	$1,418,080
B. Sublettes Flat Dam & Pump System	
1. Construction ($6,274,500)	$ 461,800
2. Project Administration and Engineering Services ($1,419,200)	104,450
3. Operation	133,100
4. Maintenance	62,750
5. Replacement	1,870
Subtotal	$ 764,070
TOTAL ADVERSE EFFECTS	$2,182,130
NET BENEFICIAL EFFECTS	$2,077,070

ENVIRONMENTAL QUALITY ACCOUNT

Components	Measure of Effects
BENEFICIAL AND ADVERSE EFFECTS	
A. Quality consideration of water, land and air resources.	1. Reduce TDS by 41.57 mg/l in the Green River at Green River, WY and by 8.18 mg/l in the Colorado River at Imperial Dam, California.
	2. Reduce Big Sandy River salt loading to the Green River from 157,600 tons annually to 73,300 tons.
	3. Increase hayland production an average of 0.197 tons/ac./yr.
	4. Conserve water by improving on-farm irrigation efficiency from 39% to 62% and project efficiency from 32% to 46%.
	5. Pump 6,900 ac.ft. of saline water to Sublettes Flat for eventual evaporation.
B. Areas of natural beauty.	1. Improve visual quality of Big Sandy River from Big Sandy Dam downstream to Gasson Bridge by increasing streamflows.
	2. Degrade visual quality of Big Sandy River from Gasson Bridge to Green River by decreasing streamflows.
	3. Provide 4,140 acres of water surface for wildlife refuge in a high plains desert setting.
C. Biological resources and selected ecosystem.	1. Change 142 acres of various woody ditch banks and border dikes to irrigated hayland.
	2. Change 1,500 acres of hayland irrigated by flooding to a sprinkler irrigation method.
	3. Dry up saline seeps or reduce flows in seeps below the Big Sandy Reservoir.
	4. Provide additional water for instream fishery flows from Big Sandy Reservoir to Gasson Bridge on release schedule recommended by the Wyoming Game and Fish Department.
	5. Reduce water supplies to 3,903 wetland ac. and eliminate 130 wetland ac. of types 1,2,3,4,9,10 & 11.
	6. Create a 4,140 acre wetland complex suitable for waterfowl and several other aquatic and semi-aquatic species.
D. Irreversible or irretrievable commitments of resources.	1. Change 4,140 acres of rangeland to reservoir area.
	2. Consume an undetermined amount of fossil fuels during construction and operation of project.
	3. Commit labor for project operation and maintenance.

REGIONAL DEVELOPMENT ACCOUNT

Components	Measure of Effects: State of Wyoming (Average Annual Dollars) 1/	Measure of Effects: Rest of Nation (Average Annual Dollars) 1/
Income		
BENEFICIAL EFFECTS		
A. The value of increased outputs of goods and services to users.		
1. Salinity reduction	$ 819,400 4/	$3,402,900 2/
2. Irrigation	336,900	- -
3. Additional wages and salaries accruing to the region from implementation of:		
a. Project OM&R	561,300	-561,300
b. Sublettes Flat OM&R	197,800	-197,800
B. The value of outputs to users residing in the region from monetary external economies. 2/		
1. Indirect activities associated with increased net returns from irrigation and reduced damages from salinity reduction.	1,205,070	6,067,860
2. Returns due to change in employment.	954,100	- -
Beneficial Effects	$3,725,370	$8,711,660
TOTAL BENEFICIAL EFFECTS	$12,437,030	
Employment:		
BENEFICIAL EFFECTS		
A. Increase in number and types of jobs.	WORK-YEARS	
1. Employment for project construction	7.67 Semiskilled 20.53 Skilled	- - - -
2. Employment for project OM&R	75.01 Semiskilled	- -
3. Employment for accelerated land treatment	0.86 Semiskilled 3.29 Skilled	- - - -
4. Indirect activity	24.11 Semiskilled	121.37
TOTAL BENEFICIAL EFFECTS	108.25 Semiskilled 23.82 Skilled	121.37

Components	Measure of Effects: State of Wyoming (Average Annual Dollars) 1/	Measure of Effects: Rest of Nation (Average Annual Dollars) 1/
Income		
ADVERSE EFFECTS 3/		
A. The value of resources contributed net in the region to achieve outputs.		
1. Multipurpose salinity storage reservoir and irrigation		
a. Project installation (Irrigation)	- -	$ 741,800
b. Project installation (reservoir)	- -	461,800
c. Project OM&R	- -	561,300
d. Sublettes Flat OM&R	- -	197,800
2. Project Administration and Engineering Services	- -	219,430
Adverse Effects	- -	$ 2,182,130
TOTAL COST	$ 2,182,130	
Net Beneficial Effects	$ 3,775,370	$ 6,529,530
Employment	WORK-YEARS	
ADVERSE EFFECTS		
None		
NET BENEFICIAL EFFECTS	108.25 Semiskilled 23.82 Skilled	121.37 - -

SOCIAL WELL-BEING ACCOUNT

Components	Measure of Effects
BENEFICIAL AND ADVERSE EFFECTS	
A. Real Income Distribution	1. Create 132 work-years of jobs for area residents and 124 jobs in Lower Colorado Basin.
	2. Regional income benefits of $3,775,370 will be distributed by income class as follows:

INCOME CLASS($)	% in INCOME CLASS	% BENEFITS in INCOME CLASS
Less than 5,000	17	10
5,000 to 15,000	71	60
More than 15,000	12	30

B. Life, health, safety	1. Improve waterfowl hunting.
	2. Improve stream fishing.
	3. Increase mosquito breeding areas.
	4. Provide wildlife refuge for various recreation activities.
	5. Increased output will be in livestock production.
	6. Reduction in salt will decrease cost of water treatment while enhancing water quality.

NOTE: Land treatment benefits evaluated. Land treatment costs are $114,980 (Technical Assistance).

1/ 50 years at 7 1/8 percent interest (0.07360). Price base 1979.

2/ Source: Salinity Management Options for the Colorado River - damage estimates and control program impacts. June 1979. Consortium of Water Resources Centers in Arizona, California, Colorado, and Utah.

3/ Project evaluation resulted in insufficient local benefits to handle normal cost-sharing or OM&R. Landowners would be unable to pay for local benefit accural.

4/ Downstream in Wyoming.

SEPTEMBER 1980

FIGURE 3-5 SUMMARY COMPARISON OF IMPACTS FOR ALTERNATIVES NED, EQ, AND LANDOWNER PREFERRED-MODIFIED BIG SANDY RIVER UNIT SALINITY STUDY, WYOMING

Accounts	Unit	NED Alternative (8)	Landowner Preferred-Modified Alternative (12)	EQ Alternative (13)	Alternative 12 Minus NED Alternative	Alternative 12 Minus EQ Alternative
A. NATIONAL ECONOMIC DEVELOPMENT						
1. Plan elements evaluated for benefits and costs						
a. Beneficial effects	av.ann.$	7,514,800	6,744,200	4,259,200	-770,600	2,485,000
b. Adverse effects	av.ann.$	1,721,190	2,623,950	2,133,020	902,760	490,930
c. Net beneficial effects	av.ann.$	5,793,610	4,120,250	2,126,180	-1,673,360	1,994,070
B. ENVIRONMENTAL QUALITY (Beneficial and adverse effects)						
1. Areas of natural beauty						
a. Change hayland cover to range or pasture land	acres	14,080	12,285	None	-1,795	12,285
b. Improve visual quality of Big Sandy River from Big Sandy Dam downstream by increasing streamflows	yes/no	Yes	Yes	Yes	--	--
c. Change rangeland and saline flats to saline reservoir	acres	--	--	4,140	--	-4,140
2. Quality consideration of water, land, and air resources						
a. Reduce TDS in Green River in Wyoming	mg/l	67.40	60.92	41.57	-6.48	19.35
b. Reduce TDS in Colorado R. at Imperial Dam, California	mg/l	16.04	14.30	8.18	-1.74	6.12
c. Reduce Big Sandy R. salt loading to the Green River	tons/yr	124,900	114,270	84,250	-10,630	30,020
d. Increase hayland production	tons/ac	- -	0.478	0.197	0.478	0.281
e. Improve on-farm irrigation efficiency	from 39 to %	No irrigation	56 3/	62	- -	23
f. Improve irrigation project efficiency	from 32 to %	No irrigation	56 3/	43	- -	11
3. Biological resources and selected ecosystems						
a. Change hayland to rangeland.	acres	14,080	12,285	--	-1,795	12,285
b. Change various weedy ditch banks and border dikes to irrigated hayland	acres	- -	- -	142	- -	-142
c. Change various weedy ditch banks and border dikes to rangeland.	acres	2,500	2,466	- -	-124	2,466
d. Change hayland irrigated by flooding to some other irrigation method	acres	- -	370	1,500	370	-1,130
e. Dry up saline seeps or reduce flows in seeps below Big Sandy Reservoir	yes/no	Yes	Yes	Yes	- -	- -
f. Provide additional water for instream fishery flows from Big Sandy Reservoir to Gasson Bridge on release schedule recommended by the Wyo. Game and Fish Dept. 1/	ac-ft	57,600	51,200	11,000	-6,400	40,200
g. Reduce water supplies to existing wetlands	acres	1,010	1,010	3,503	0	-2,493
h. Eliminate existing wetlands	acres	2,765	2,623	130	-142	2,493
i. Mitigate adverse effects on wetlands by preserving and enhancing wetlands (Types 3,4,9,10,11)	acres	862	862	- -	0	862
j. Mitigate adverse effects on wetlands by enhancing terrestrial habitat adjacent to preserved wetlands	acres	430	430	- -	0	430
k. Increase waterfowl breeding potential in watershed	yes/no	Yes	Yes	Yes	- -	- -
l. Increase open water wetlands	acres	- -	- -	4,140	- -	-4,140
m. Disrupt and change migration patterns of antelope in Sublettes Flat area	yes/no	No	No	Yes	- -	- -
n. Increase potential for hayland depredation by waterfowl	yes/no	No	No	Yes	- -	- -
o. Induce undetermined impact on black-footed ferret habitat in Sublettes Flat area 2/	yes/no	No	No	Yes	- -	- -
4. Irreversible or irretrievable commitment of resources						
a. Change rangeland to saline reservoir	acres	- -	- -	4,140	- -	-4,140
b. Consume an undetermined amount of fossil fuels during construction and operation of project	yes/no	Yes	Yes	Yes	- -	- -
c. Commit labor for project operation and maintenance	yes/no	Yes	Yes	Yes	---	---
d. Evaporate saline water in Wyoming	ac-ft/yr	- -	- -	6,900	- -	-6,900
e. Flood area known to have experienced archeological and historical activity 2/	acres	- -	- -	2/	- -	2/
C. REGIONAL DEVELOPMENT (State of Wyoming)						
1. Plan elements evaluated for benefits (including external economies) and costs						
a. Beneficial effects	av.ann.$	3,317,280	3,604,500	5,088,300	287,220	-1,483,800
b. Adverse effects	av.ann.$	4,290,800	4,914,100	None	623,300	4,914,100
c. Net beneficial effects	av.ann.$	-973,520	-1,309,600	5,088,300	-336,080	3,778,700
2. Employment caused by either/or project construction, OM&R, accelerated land treatment, indirect activities, and wetland mitigation in both agricultural and non-agricultural sectors	Man-Years	56	55	133	-1	-78
D. SOCIAL WELL-BEING (Beneficial and adverse effects)						
1. Decrease livestock grazing around wetlands	yes/no	Yes	Yes	No	---	---
2. Improve waterfowl hunting in watershed	yes/no	No	No	Yes	- -	- -
3. Increase stream fishing opportunities	yes/no	Yes	Yes	Yes	- -	- -
4. Improve economic stability of ranch units	yes/no	No	Yes	Yes	- -	- -
5. Increase or decrease Wyoming's use of Colorado River Compact water.	± ac-ft	+26,190	+21,190	-5,230	-4,600	+26,820
6. Decrease tax base of watershed	yes/no	Yes	Yes	No	- -	- -

1/ Excess water must be released from reservoir. Release schedules for fish flows would need to be arranged with post-project dam operator/s.

2/ Development of Sublettes Flat Reservoir would be undertaken as an individual project by an agency. The specific EIS for this development would need to identify actual impacts on endangered species and/or archeological and historical resources.

3/ Increased efficiency for 2,000 acres of irrigated land. (13,700 acres will be retired from irrigation).

SEPTEMBER 1980

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CHAPTER 4

IMPLEMENTATION OF ALTERNATIVES

Implementation Issues

The following discussion is presented to alert the reader to the major issues that developed during the course of the Big Sandy River Salinity Study. These issues are beyond the scope of this study and would take considerably more time to resolve than time allows for completion of this report.

The landowners are concerned about the salinity problems and want to implement action as soon as possible. This will require close coordination between State and Federal governmental agencies to help the landowners to implement an effective salinity reduction plan.

Funding and Cost-Sharing Policy

The Local Coordinating Committee, local landowners at the public meetings, and the Wyoming State Engineer have stated that to implement a salinity program in the Big Sandy Area the Federal Government should pay both the cost of installation and the costs of operation, maintenance, and replacement for needed irrigation improvement measures. This may seem to be an unrealistic request on first appearance, but when analyzed further may not be that unrealistic. It should be noted that the major part of the benefits for the alternatives considered are derived from salinity reduction to the Lower Colorado River Basin (i.e., Imperial Dam). Consequently, a minor portion of the benefits come from increase agricultural production from the irrigation project. The economic evaluation of the project shows that the landowners are presently netting approximately $47.00 per acre or about $8,900 for an average farm of 190 acres. The main reason for the low net income is that agricultural production from the Eden Irrigation Project area is limited by the short growing season of approximately 90 days. It is further noted that a killing frost can occur any month of the year, which limits major cropping pattern changes. Due to the climate, minimal response for increased agricultural production occur with the installation of improved irrigation water management equipment. This minimal agricultural increase has b
by personal interviews with local farmers who preser
irrigation systems on their farms.

Federal Government would cost-share OM&R, many of the local landowners may change their choice from irrigation retirement to an improved irrigation management alternative. This cost-share would need to be based on a fair dollar return to the landowner for installation of irrigation water management measures on their farm. If a cost-share policy is adopted for OM&R, then the local landowners should be contacted to determine the acreage that they want to change from irrigation retirement to an agricultural farming alternative.

Most of the landowners responding to the Local Coordinating Committee questionnaire indicated that compensation would need to be approximately $2,000 per irrigated acre for the Land Retirement Alternative. The $2,000 per acre would include and be considered full compensation for all farm equipment, buildings, remnant acreage, appraisal and moving expenses, etc. In addition, they indicated that the capital gains tax be deferred or the landowner be given an extended time to reinvest the money obtained from the land retirement sale. The $2,000 per irrigated acre is somewhat higher than the present market value of the land, farm equipment and buildings, remnant acreage, retirement of mortgage, appraisal and moving expenses, etc. An economic analysis indicates a break-even cost to the landowner (no profit included) to be approximately $1,300 per irrigated acre for the Land Retirement Alternative (6). Alternative 6 (Land Retirement) is shown in Appendix C, Figure C-5.

A majority of the landowners responding to the Local Coordinating Committee questionnaire, that chose Irrigation Retirement, indicated that $2,000 per irrigated acre would be acceptable as full compensation for giving up water rights, irrigation improvements, and their farm equipment used in the irrigation operations, etc. The landowner's desire was to retain ownership of the land along with all mineral rights. The economic analysis indicates a break-even cost to the landowner (no profit included) to be approximately $1,400 per irrigated acre for Irrigation Retirement. A livestock operation was assumed for those landowners desiring this alternative. Alternative 8 (Irrigation Retirement) is shown in Chapter 3, Figure 3-2.

Both Land Retirement and Irrigation Retirement assume that the landowner will compensate the Federal Government to retire the existing project mortgages. The Landowner Preferred-Modified Alternative (Alternative 12), shows 13,700 acres to be retired from irrigation. Again the cost used per irrigated acre was $2,000. The cost to provide irrigation improvements on the remaining 2,000 acres of land that would continue to be irrigated is $3,425 per acre. Although this alternative used $2,000 per acre for retirement and $3,425 per acre for continued irrigation, the salinity reduction benefits are far in excess of the costs.

Water

Throughout the development of salinity reduction alternatives, an account of terrestrial wildlife habitat (ditch banks, farm head ditches, border dikes, etc.) and wetland losses have been kept. Coordinating with the Wyoming Game and Fish Department and the Fish and Wildlife Service, a mitigation plan has been developed for each alternative. To

mitigate habitat and wetland losses, wetlands will need to be developed, which will require a water supply. Present State of Wyoming water law does not recognize stream diversion to maintain wetlands as a beneficial use of water. To federally implement a salinity reduction plan and follow the rules and regulations (40 CFR Part 1500-1508, November 28, 1978) set forth by the Council on Environmental Quality (CEQ), water will need to be designated to maintain wetlands. It would appear that some compromise will be needed between the CEQ and the State of Wyoming to implement the mitigation measures in any salinity reduction alternative selected for implementation.

Each alternative was analyzed to determine the amount of water that would not be needed for diversion to the farms. It was not the intent of the study to determine what use this water may have. Should this water be allocated to municipal, industrial, irrigation, or to wildlife uses, it would require a separate salinity and environmental impact analysis. It should be noted that this is not extra water to the Big Sandy River System. The change is that instead of the water flowing from the irrigated area underground and then back into the river, it would be released from the reservoirs. Working with the Wyoming Game and Fish Department, a water release schedule was provided which would improve downstream fish habitat. The release of water for improved fish habitat is not recognized as a beneficial use of water by the State of Wyoming.

Alternative 10 is the pumping of saline water into Sublettes Flat for evaporation and for a wildlife refuge. In consultation with the Wyoming State Engineer, it was indicated that the State will not allow the water for evaporation to come from its Colorado River Compact allocation. While this alternative is feasible, it is not viable if the State of Wyoming will not consider evaporation of saline water in Sublettes Flat, and development of an associated wildlife refuge as beneficial use of the water.

Implementing Agency

No determination or recommendation has been attempted as to the institutional arrangements necessary to implement the Landowner Preferred-Modified Alternative. Because of complexity and scope of the project, the implementing vehicle will have to be determined at a later time. It should be noted that if Congress provides funds to implement the Landower Preferred-Modified Alternative, the landowners will be provided the opportunity to determine that part of the salinity reduction alternative they favor. Negotiations will be between the landowner and implementing agency.

Landowner Preferred-Modified Alternative

The Landowner Preferred-Modified (Alternative 12) consists of retirement from irrigation 13,700 acres of irrigated farmland. The remaining 2,000 acres of project lands would continue to be irrigated. Irrigation water management measures for the 2,000 acres are listed as follows:

90 Acres - No change from present condition.

420 Acres - Minimal structural improvements.

880 Acres - Automated border and sprinkler irrigation.

610 Acres - Irrigation water reduction to approximately 2 ac.ft./Ac.

Three pumping plants would be constructed along the Big Sandy River and a distribution pipeline would be installed to deliver the irrigation water to the remaining farmland (see Figure 4-1). In addition, this system would provide the water to maintain the designated wetland areas.

Implementation of the Landowner Preferred-Modified Alternative would require an expenditure of approximately $35,879,000 (Price Base - 1979). This cost includes approximately $28,770,000 for the retirement of 13,700 acres of land from irrigation, $5,534,000 for installation of structural measures for the remaining 2,000 acres of irrigated land, and $1,575,000 for mitigation of wetlands. In addition, an average annual cost of $140,100 would be required for operation, maintenance, and replacement. See Table 4-1 for breakdown of costs for the Landowner Preferred-Modified Alternative.

The wetland mitigation cost of approximately $1,575,000 includes costs for installation of structural measures, land purchase, and for water rights. In addition, an average annual cost of $43,300 would be required for operation, maintenance, and replacement.

The cost for retirement of 13,700 acres was computed using $2,000 per irrigated acre. The local landowners have suggested this to be the price to retire irrigation from the Eden Valley.

Effects of Landowner Preferred-Modified Alternative

The expected results for implementation of the Landowner Preferred-Modified Alternative will be a salt reduction of 113,400 tons in the Colorado River System and an increase in average annual flow in the Big Sandy River by 21,600 acre-feet. This alternative reduces the salt concentration by 14.3 milligrams per liter in the Colorado River at Imperial Dam and 60.9 milligrams per liter in the Green River at Green River, Wyoming.

All effects of the Landowner Preferred-Modified Alternative are analyzed as if no additional water development will be made of the 21,600 acre-feet of river flow in Wyoming. It is recognized that any reduced use of water is under the jurisdiction of the Wyoming State Engineer. It was not the intent of the study to determine what use this water may have. Should this water be allocated to municipal, industrial, irrigation, or to wildlife uses it would require a separate salinity and environmental impact analysis. The benefits derived are the result of the salinity reduction in the Colorado River at Imperial Dam and in the

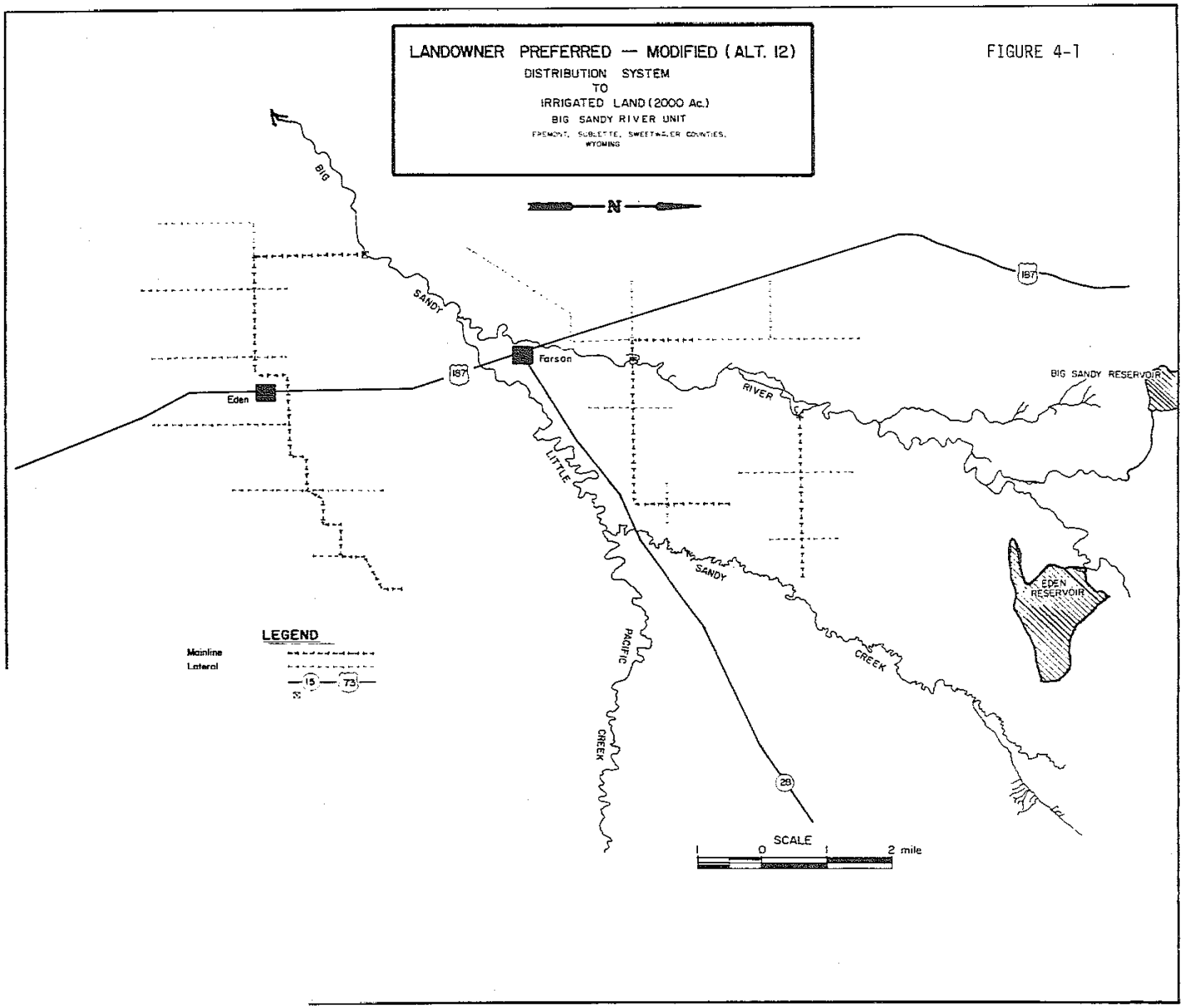
LANDOWNER PREFERRED — MODIFIED (ALT. 12)
DISTRIBUTION SYSTEM
TO
IRRIGATED LAND (2000 Ac.)
BIG SANDY RIVER UNIT
FREMONT, SUBLETTE, SWEETWATER COUNTIES, WYOMING
N
BIG SANDY RIVER
Farson
Eden
187
28
BIG SANDY RESERVOIR
EDEN RESERVOIR
LITTLE SANDY CREEK
PACIFIC CREEK
LEGEND
Mainline
Lateral
SCALE
0
1
2 mile

FIGURE 4-1

Table 4-1 Landowner Preferred-Modified Alternative Cost Breakdown, Big Sandy River Unit Salinity Study, Wyoming

Item	Construction Cost	Project Admin. and Eng. Services Cost	Total Installation Cost	Average Annual Installation Cost 1/	Annual Replacement Cost	Annual Operation & Maintenance Cost	Total Average Annual Cost
	(Dollars)						
On-Farm Irrigation Systems Improvement	1,419,540	135,400 2/	1,554,940	114,440	15,910	--	130,350
Pump Plants	266,500	41,300	307,800	22,650	3,690	--	26,340
Switch Yard & Electric Equipment & Accessory	771,000	119,500	890,500	65,540	--	--	65,540
Distribution Pipeline	2,407,500	373,200	2,780,700	204,660	--	--	204,660
Irrigation Operation and Maintenance	--	--	--	--	--	77,270	77,270
SUBTOTAL	4,864,540	669,400	5,533,940	407,290	19,600	77,270	504,160
Retirement	27,400,000 3/	1,370,000 4/	28,770,000	2,117,470	--	--	2,117,470
Wetland Mitigation	1,216,780	358,250 5/	1,587,030	115,920	16,920	--	132,840
Mitigation Operation and Maintenance	--	--	--	--	--	26,340	26,340
TOTAL	33,481,320	2,397,650	35,878,970	2,640,680	36,520	103,610	2,780,810

1/ Annual cost at 7 1/8 percent interest for 50-year life.

2/ Technical assistance for 2,000 acres of irrigation system improvements.

3/ Retirement cost computed at $2,000 per acre for 13,700 acres per request of landowners.

4/ Project administration for retirement of 13,700 acres.

5/ Includes cost for water rights.

Green River at Green River, Wyoming and not for additional water development. These benefits are based on a value of $416,000 1/ and $12,495 2/ for each milligram per liter reduction at Imperial Dam and at Green River, Wyoming, respectively. These values are for June 1979 and represent the damage caused by salinity to downstream water users, especially agriculture, municipal, and industrial.

Other economic benefits come from increased crop production due to increased irrigation efficiencies.

Environmental Effects of Landowner Preferred-Modified Alternative

The overall environmental impacts for the type of structural and nonstructural measures included in the Landowner Preferred-Modified Alternative have been addressed in the final program EIS (Colorado River Water Quality Improvement Program, USDI--Water and Power Resources Service and USDA--Soil Conservation Service) filed with CEQ on May 19, 1977. More detailed impacts are displayed in Chapter 3, Figure 3-3, page 3-21 of this report. Details of the wetland mitigation plan developed by the Soil Conservation Service, Wyoming Game and Fish Department, and the U.S. Fish and Wildlife Service are presented in Chapter 3, on page 3-17.

The installation of the Landowner Preferred-Modified Alternative is not expected to have any effect on endangered species that may be present in the study area. Formal consultation with the U.S. Fish and Wildlife Service as per the Endangered Species Act Amendment of 1978 will be initiated prior to implementation of any plan. The implementing agency will comply with the Endangered Species Act before installation.

According to the State Historic Preservation Officer, there are several cultural sites located in or near the irrigated area. Compliance with Section 106 of the National Historic Preservation Act of 1966 (16 USC Sec. 470(f), as amended, 90 Stat. 1320) will be required. The Advisory Council on Historic Preservation's regulations, "Protection of Historic and Cultural Properties" (30 CFR Part 800) will be followed. Eligibility for recovery and/or nomination to the National Register of Historic Places will also be determined. If the Soil Conservation Service were the implementing agency, the following procedure will be followed.

The State Historic Preservation Officer and the Division of Interagency Archeological Services of the Heritage Conservation and Recreation Service would be advised of any Soil Conservation Service plans for detailed testing, survey, and recovery. They would also be asked to

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1/ "Salinity Management Options for the Colorado River - Damage Estimates and Control Program Impacts." June, 1979, prepared by consortium of Water Resources Centers in the States of Arizona, California, Colorado, and Utah.

2/ Salinity damages per milligram per liter obtained by SCS from municipal and industrial water users of Green River water in Wyoming.

comment whether the sites are eligible for National Register of Historic Places. In addition, these agencies and the Advisory Council on Historic Preservation would be given a reasonable opportunity to comment on any proposed plan for survey, recovery, and protection. If any cultural resources are discovered during construction, the Soil Conservation Service would follow the requirements in the final rule, 7 CFR, Part 656, "Procedures for the Protection of Archeological and Historical Properties Encountered in SCS assisted Programs".

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CHAPTER 5

COMMENTS

DICK CHENEY
WYOMING

Congress of the United States
House of Representatives
WASHINGTON, D.C. 20515

May 23, 1979

Dear:

We have been following the Farson hearings regarding the Soil Conservation Service's Big Sandy Salinity Control Study and have enclosed for your use the Colorado River Basin Salinity Control Act which authorized this study.

The 1974 Act directs the Secretaries of the Interior and Agriculture to complete and submit a planning report on the Big Sandy salinity problems to the Colorado River Basin States and other appropriate parties for review and comment. This was the reason for the Farson hearings.

The Soil Conservation Service will now draft a report for consideration and comment from other staffs within the Departments of the Interior and Agriculture and the Colorado River Basin Salinity Control Advisory Council which has three Wyoming representatives.

This report will then be transferred to the Secretary of the Interior who will submit a final report with his recommendations simultaneously to the President, several government agencies and to the Senate Committee on Energy and Natural Resources, on which Senator Wallop serves, and to the House Committee on Interior and Insular Affairs, on which Congressman Cheney serves.

The Act further provides that if no action is taken or Congress approves the report within sixty days after the report is submitted, funds may be appropriated.

This process will take at least six months and may take longer, and we can sympathize with any frustrations that you may encounter. However, we are following this matter closely, and when the Secretaries' recommendations come to Congress, we will be in a position to express your thoughts and concerns on this matter.

Please keep in touch with us on this situation.

Best regards,

Malcolm Wallop
United States Senator

Alan Simpson
United States Senator

Dick Cheney
Member of Congress

Enclosure

Chapter 5

COMMENTS

Salinity Report Distribution List

Following is a list of those sent a copy of the March 1980 Interagency and Public Review Draft of the (Big Sandy River, Colorado River Basin Salinity Control Study) report. Recipients of the report were encouraged by letter to submit written comments to Frank Dickson, Wyoming State Conservationist (Soil Conservation Service), by May 1, 1

The Congress:

U.S. Representative of Wyoming
U.S. Senators of Wyoming

Federal Agencies:

* Advisory Council on Historic Preservation
Agricultural Stabilization and Conservation Service
* Bureau of Land Management
Economics, Statistics, and Cooperatives Service
Environmental Protection Agency
Farmers Home Administration
* Heritage Conservation and Recreation Service
Office of Federal Activities
Science and Education Administration Agricultural Research Service
* USDA - Forest Service
USDA - Soil Conservation Service
* USDI - Water and Power Resources Service
* U.S. Fish and Wildlife Service
U.S. Geological Survey

State of Wyoming:

* Agricultural Extension Service (University of Wyoming)
Department of Economic Planning and Development
* Department of Environmental Quality
* Governor of Wyoming
State Conservation Commission
* State Engineer's Office
Wyoming Agricultural Planning and Development
* Wyoming Department of Agriculture

* Responded to request for comments

State of Wyoming (Continued)

* Wyoming Game and Fish Department
* Wyoming Planning Coordinator
* Wyoming Recreation Commission
* Wyoming Water Development Commission

Other:

* Big Sandy River Local Coordinating Committee (9 copies)
* Colorado River Salinity Control Advisory Council (25 copies)
* Ducks Unlimited
  Eden Valley Irrigation and Drainage District - Attorney-at-Law
* Landowners (Irrigated Farmland) of Eden Valley (110 copies)
  Izaak Walton League
  League of Women Voters
  Local Newspaper Correspondents (2 copies)
  Sierra Club
  Trout Unlimited
  University of Wyoming
  Rocky Mountain Energy Company

* Responded to request for comments

Letters of Comment Received on Interagency and Public Review Draft

Copies of original letters of comment appear on the following pages:

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
Billings Area Office
Federal Building, Room 3035
316 North 26th Street
Billings, Montana 59101

IN REPLY REFER TO:

ES

April 8, 1980

Mr. Frank S. Dickson
State Conservationist
U.S. Soil Conservation Service
P.O. Box 2440
Casper, WY 82602

Dear Mr. Dickson:

We have reviewed the Interagency and Public Review Draft of the Big Sandy River Salinity Study Report. We find it well written, accurate, and comprehensive in its analysis of impacts on fish, wildlife, and related environmental resources.

The report cites the American peregrine falcon, bald eagle, and black-footed ferret as endangered wildlife species possibly occurring in the project area. Selection of an alternative or combination of alternatives for further action and preparation of an EIS should include a biological assessment of project effects on these species as required by the Endangered Species Act Amendments of 1978. If it is determined they may be affected, formal consultation must be requested from the Fish and Wildlife Service. Since several endangered species of fishes occur downstream in the Colorado River system, the effects on them should also be considered. Prior to the development of your biological assessment under Section 7, a list of endangered, threatened, and species proposed for listing that may occur in the project area should be requested from the Regional Director, Fish and Wildlife Service.

If alternative IO is selected, our Service can provide many specific details to enhance its success. We can also provide further help with wetland mitigation proposals that may be selected.

We appreciate the opportunity to work closely with you on the project through the early stages of planning and analysis. If we can be of further assistance, please let us know.

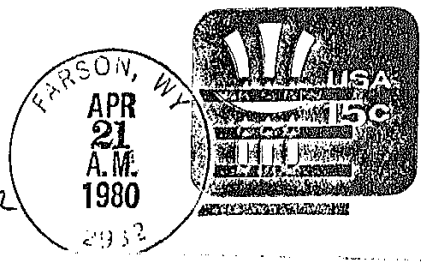
Sincerely,

Paul F Berg

Paul F. Berg
Acting Area Manager

cc: Director, Wyoming Game and Fish Department, Cheyenne, WY
District Supervisor, Wyoming Game and Fish Department, Lander, WY
BLM, Rock Spring, WY
Mr. Harold Serswland, WPRS, Salt Lake City, UT
Mr. Ron Garst, USFWS, Salt Lake City, UT
SE, USFWS, Billings, MT
Mr. Marv Plenart, USFWS, Denver, CO (RW)

Mason E. Heathman
Box 9
Farson Wyo. 82932



Mr. Frank S. Dickson

4/20/1980

Dear Sirs

This Letter is in reply to the Salinity study.
Because of this study I am one year behind.

Now, as far as I am concerned the goverment can do one or two things, either buy me out or leave me alone.

I am equally sure they will do Neither!
Here is what they (Bureaucrats) will do,
Bleed the American Taxpayer with some harebrained scheme For Reducing the salt, and starve me out at the same time.

Sincerely
Mason E. Heathman

THE STATE OF WYOMING

ED HERSCHLER
GOVERNOR

Wyoming Recreation Commission

604 EAST 25TH STREET CHEYENNE, WYOMING 82002

JAN L. WILSON
Director
777-7695

April 15, 1980

Frank S. Dickson
State Conservationist
Soil Conservation Service
P.O. Box 2440
Casper, Wyoming 82602

RE: Big Sandy River Salinity Study Report

Dear Mr. Dickson:

Thank you for the opportunity to review and comment on this project.

I have enclosed recommendations concerning archeological and historical clearance of the project and concur with them.

The State Historic Preservation Officer (SHPO) will make recommendations concerning cultural clearance of individual projects as they arise.

If you have any questions, please feel free to contact this office.

Sincerely,

John F. Carlson, Chief
Resources Division and
Deputy SHPO

FOR:

Jan L. Wilson, Director and
State Historic Preservation Officer

JFC:klm
Encls.

cc: State Planning Coordinator

WYOMING RECREATION COMMISSION

STATE HISTORIC PRESERVATION OFFICE

REVIEW AND COMPLIANCE

Interdisciplinary Staff Comments

Archeology • History • Historical Architecture • Recreation Planning

TO John F. Carlson, Chief

FROM Gregory D. Kendrick, Survey Historian GK

DATE April 7, 1980

RE Interagency and Public Review Draft of the Big Sandy River Salinity Study Report

The study outlines several alternatices to reduce and control the salinity of the Big Sandy and Colorado Rivers. Although no specific geographic areas are outlined, those portions subject to surface modifications when determined, should be reviewed for their potential impact upon cultural resources.

WYOMING RECREATION COMMISSION

STATE HISTORIC PRESERVATION OFFICE

REVIEW AND COMPLIANCE

Interdisciplinary Staff Comments

Archeology • *History* • *Historical Architecture* • *Recreation Planning*

TO: John Carlson

FROM: Tom Larson, Associate State Archeologist

DATE: April 8, 1980

RE: USDA-Forest Service, Big Sandy River Salinity Control Study

A cultural resource inventory of all of the proposed structural measures areas is recommended prior to initiation of any construction.

STATE OF WYOMING

ED HERSCH
GOVERNOR

Wyoming Department of Agriculture

TELEPHONE: (307) 777-7321

CHEYENNE, WYOMING 82002

MEMORANDUM

April 22, 1980

To: Warren White
State Planning Coordinators Office

From: Kenneth R. Sturman, Director
Ag Planning and Development K.R.S.

Subject: Big Sandy River
Colorado River Basin Salinity Control Study

The following comments on the Big Sandy River Salinity Control Study Report are submitted to you for your consideration.

1. The salinity on the Big Sandy Project is natural and man caused and should be approached in that manner and a program designed to control salinity whenever possible.

2. The Wyoming Game and Fish Department and the U.S. Fish and Wildlife Service should be required to contract for and reimburse the project irrigators to a fair and equitable price for committed project or excessive waters that are released on a scheduled basis to improve downstream fish or wildlife habitat. This type of action would provide a portion of the mitigation requirements to the irrigator for the loss of water for agricultural use.

3. The two federal agencies who are making the study (USDA-Soil Conservation Service, and the USDI-Water and Power Resources Service), should coordinate their studies with the State of Wyoming and develop the best solutions or alternatives possible to control the salinity from the project as well as natural causes.

4. The land owners and renters on the project should be given the opportunity to work with the federal and state agencies in developing a water and land management system that will allow them to continue their agricultural practices but also assist in reducing the salinity problems created by man and natural causes in the Big Sandy drainage area.

5. If there is money available through the Colorado River Salinity Control Act to help control salinity those funds should be used to do remedial work on the Eden-Farson Project at no cost to the owners.

6. Grants and low interest rates for money needs based upon the economic feasibility of various programs should be made available to the people on the project so they could and would install the various conservation practices that would provide better land management, water management, energy saving, labor requirements and provide greater crop and livestock yields, as well as, help prevent and control the Big Sandy Salinity cause.

7. A thorough study should be conducted as to the feasibility of converting the present irrigation system on the project from flood irrigation to gravity sprinkler irrigation both high and low pressure.

8. Owners and operators on the project should be involved with the studies and be kept abreast of federal and state action.

KS/lms

cc: Larry J. Bourret, Commissioner

THE STATE OF WYOMING

ED HERSCHLER
GOVERNOR

Department of Environmental Quality

Water Quality Division

HATHAWAY BUILDING

CHEYENNE, WYOMING 82002

TELEPHONE 307 777-7781

MEMORANDUM

TO: Robert E. Sundin
Director
Dept. of Environmental Quality

FROM: Larry Robinson
Planning Coordinator
Water Quality Division

DATE: April 1, 1980

SUBJECT: Comments on Draft of Big Sand Salinity Study prepared by USDA due April 28, 1980.

1) Page S-2, line 14. It is indicated that the Big Sandy River is contributing 149,200 tons/year of salt for the period 1960 through 1977. This figure is adjusted to 157,600 tons/year later in the report. The 208 plan, "Clean Water Report for Southwestern Wyoming" indicates that the loading for the period 1970-75 was approximately 270,000 tons/year (page 5-5). Can the difference in these loadings be accounted for due to differences in annual run-off or is there a basic difference in estimating the salt loading?

2) Page S-5, Table S-1. The table shows the salt load reduction equal for the land retirement and irrigation retirement alternatives. This does not appear realistic in that grazing activities would undoughtably increase erosion and salinity loading to some degree.

3) Page I-5, line 17. Statement is made that the Big Sandy Reservoir does not contribute significantly to saline aquifer problem. This does not appear to be consistent with the 208 management plan (see page 5-46) which indicates that water resource development within the contact zone will contribute significantly to salt loading. Directly or indirectly through irrigation the reservoir is a significant source of salinity loading.

4) Page 1-1, line 20. See comment #1 relative to average annual salt loading. This comment also applies to other sections of the report where salt loading is refered to.

5) Page 4-3, line 27. It is indicated that landowners desire to retain ownership and all mineral rights if the irrigation refinement alternative is implemented. The 208 plan identifies certain sensative areas where construction, surface mining, and drilling activities will significantly increase salinity loading. If such activities replace irrigation salinity loadings should be adjusted accordingly and reflected in the economic analysis of the alternative being evaluated.

THE STATE OF WYOMING

ED HERSCHLER
GOVERNOR

Water Development Commission

BARRETT BUILDING CHEYENNE, WYOMING 82002

April 24, 1980

TO: Lou Allen, State Engineer's Office
Warren White, State Planning Coordinator's Office

FROM: Mike Reese, Administrator

RE: Comments on Big Sandy River Study by Soil Conservation Service

My comments relate to what I feel is a neglect of at least one other alternative to reduce salt loading problems in the Big Sandy area. It has been suggested at the state level, and very preliminarily reviewed, that gravity flow sprinkler irrigation or siderolls, by itself or in combination with a sprinkler system powered by a pump, might be possible. Is the drop in elevation from Big Sandy Reservoir to irrigable land in Eden and Farson projects sufficient to allow gravity flow? The study does not even address this option--no evidence is supplied to indicate this was even considered and/or rejected.

Perhaps the concept of gravity flow would only apply to portions of the irrigated lands, which our preliminary evaluation indicates. SCS has not indicated this feasibility of such an option.

In addition to the above comment regarding a gravity flow system, which is my major concern, I do have some other comments.

1. I am not sure how SCS arrived at the figures for salt loading reduction. For example, in connection with Alternative 3 (sprinkler irrigation), p. 3-7, figures are provided showing a salt loading reduction to 61,300 tons per year. How are these figures arrived at? Methodology is non-existent. It is my opinion that to know how figures are arrived at is as important as the actual figures.

2. Moreover, the heart of my complaint with regard to methodology also applies to how beneficial and adverse effects are arrived at. For example, what basis is used for determining downstream benefits?

3. Obviously, if I were a landowner, I would prefer selling my lands for $2000 an acre (p. 3-27). Compensation for a landowner takes various forms and is in Alternatives 6 (land retirement); 8(irrigation retirement); 11(land owner preferred); 12(landowner preferred modified). Is the figure of $2000 on p. 3-27 per acre market value? If not, would not federal regulations prohibit compensation

above market value? If this is the case, the landowner preferred option strikes me as a window-dressing alternative, designed to appease landowners with no legal or administrative foundation. Conceptually, I feel that compensation for lands provides the purest form in solving the salt loading problem. However, I really don't know the administrative and legal details which would be necessary to implement alternative 11. Nor is there an examination of the policy considerations, if any, of taking irrigable agriculture out of production in Wyoming.

I appreciate the opportunity to comment on this study. If there are any questions, please contact me.

MR:ew

THE STATE OF WYOMING

ED HERSCHLER
GOVERNOR

State Engineer's Office

BARRETT BUILDING CHEYENNE, WYOMING 82002

April 24, 1980

TO: Warren White, State Planning Coordinator's Office

FROM. Louis E. Allen, Water Resources Engineer

SUBJECT: Comments on Public Review Draft, Big Sandy Salinity Study Report, (March, 1980).

I submit the following comments on the subject report:

1. Page I-4, lines 20-22. We object to any alternative being "selected for implementation" at this time. Such action is premature, and should not be taken until WPRS and State efforts are complete and an informed decision can be made by all concerned.

2. Page 2-6, lines 16-18. Did the Coordinating Committee or the SCS send out the summary and questionaire? This Committee member did not see the final questionaire until it had been sent to him from the SCS office in Casper.

3. Page 3-1, lines 24-25 and subsequent pages. I fail to see the practicality of drying up a wetland in one area in the name of conserving water, and then incurring costs for construction and maintenance to replace it in another area, with its attendant water losses.

4. Page 3-1, lines 25-27 and page 3-2, lines 1-2, and elsewhere. This refers to water not utilized for irrigation due to increased irrigation efficiencies, and used for instream flows on a scheduled basis. There may be some question as to how this would be accomplished. Also, if this could be done, are the Wyoming Game and Fish Department and/or the Fish and Wildlife Service willing to pay their portion of storage and O & M costs in order to share in the unused project water on a scheduled basis? If this water could be put to legally defined beneficial uses and delivered downstream on the users' schedules, the fish could certainly use it as available.

5. Page 3-15, Alternative 6 - Land Retirement. Lines 3-16 on page 3-16 make the wording more acceptable than previous forms, but it

still carries the same message and the buy out concept is still not acceptable. The question of who will own the reservoirs and the storage space in the event such a scheme did come to pass is not addressed. The question of water rights ownership is also left in limbo.

The Economic Display on page 3-16 fails to show adverse effects to the State economy from foregone production, lost taxes, and the loss of cash flow from the project.

6. Page 3-17, Alternative 8 - Irrigation Retirement. The comments here are essentially the same as for Alternative 6, above.

7. Page 3-20, Alternative 9. This alternative proposes to limit the landowner to 2.0 acre-feet of water per acre. Who is proposed to regulate this use? This must be voluntary action on the part of the landowners, as they have rights for the use of this water.

8. Page 3-22, Alternative 10. This alternative proposes pumping saline water to Sublettes Flat for evaporation. This action would waste Wyoming's compact water, as well as waste the energy required to pump the water. This is not an on-farm solution to the salintiy problem, but since it is addressed, why not substitute pumping to an industrial use in conjunction with Fontenelle Reservoir water? How long would it take for the salintiy of the evaporation pond to approach that found in the trona plant evaporation ponds, which are claimed to be hazardous to waterfowl?

9. Page 3-25, Alternative 11 - Landowner Preferred. In line 7, the location of the 2,000 acres that would continue to be irrigated would have some effect on several factors such as distribution costs and efficiency, deep percolation, and the farming efficiency. The land remaining in irrigation may not be the most desirable from the standpoints of irrigation efficiency, production, and salt loading reduction.

10. Page 3-28, Alternative 12 - Landowner Preferred, Modified. Comment Number 9 would apply to this alternative also.

11. Page 3-35, item D.2 under the EQ Account. Changing cropland to rangeland is not an irreversible or irretrievable commitment of resources. This also applies to the same item on page 3-36. Under the Social Well-Being Account, B. 1 and 2, who would benefit from any improved hunting and fishing, and what about public access to any improved hunting and fishing? See these same items on pages 3-36 and 3-37, also.

12. Page 4-3, lines 8-27. Alternative 6, Land Retirement, shows a desired buy out price of $2,000 per irrigated acre. Alternative 8, Irrigation Retirement, shows this same desired price, but the landowners would remain. This does not appear to be reasonable. In lines 15-20, a cost of about $1,300 per irrigated acre is estimated as a break-even price - indicating the landowners are requesting a windfall profit of around $700 per irrigated acre, even though they are asking to be bought out. In lines 23-27, and lines 1-4 on page 4-4, the break-even price for irrigation retirement is given as approximately $1,400 per irrigated acre. This is a $600 per irrigated acre windfall profit with the landowners desired $2,000 per irrigated acre price, and the landowners would still retain their land and mineral rights while having hay provided for their livestock. Refer to Comment Number 20, also.

13. Page 4-4, lines 16-17. "...the salinity reduction benefits are far in excess of the costs." This and similar statements in the report are based on a false premise. Salinity concentration reduction through leaving more water in the stream as it leaves the project area presumes that this water arrives at Imperial Dam undiminished in quantity. We would expect most of this water to be utilized before it reaches Imperial Dam - some in Wyoming and much of it before it escapes the Upper Basin. The salinity concentration reduction benefits to Wyoming would not meet the costs, and the benefits to downstream users would in actuality be much less than those postulated in the report. See also page 4-10, lines 6-25.

14. Page 4-5, lines 12-13. If it was not the intent of the study to determine what uses the water not needed for irrigation may have, why has so much space and effort been devoted to designating it for instream flows, evaporation, and wetlands?

15. Page 4-5, lines 25-27, and page 4-6, lines 1-5. There should be mention of the potential for industrial use of the Big Sandy water as a preferred alternative to wasting it to evaporation on Sublettes Flat.

16. Page 4-6, Lines 9-17. The uncertainty expressed in Lines 9-17 negates the specifics discussed in such a positive manner in the

Landowner Preferred-Modified Alternative section which follows this paragraph.

17. Page 4-10, line 1, "Negotiable". Everywhere else in the report, the $2,000 per irrigated acre figure is referred to as the landowners' price with no intimation of negotiation, and all of the SCS computations are based on this $2,000 figure where retirement of either land or irrigation is involved.

18. Chapter 4. The entire discussion in Chapter 4 seems oriented to the presumption that the SCS on-farm study is the final study action, rather than a small part of the WPRS Colorado River Basin salinity control program. The several alternatives evolved in the SCS study need to be evaluated along with the WPRS Big Sandy Unit results and with the efforts of the State for developing industrial uses for the water from the Big Sandy River.

19. Appendix A, page A-12, lines 11-17. In view of this paragraph, why is there so much supposed interest from the landowners in selling out?

20. Appendix B, page B-1, lines 23-26. Compare the "needed" $2,000 per irrigated acre (line 24) with the figures on sheet E of Appendix B. Alternative 6 estimates the value of land at $1,238 per irrigated acre. Alternative 8 estimates the value of land at $1,394 per irrigated acre. Again, computations - and expectations - based on a price of $2,000 per irrigated acre do not appear to be realistic.

LEA/ht

cc: George L. Christopulos
State Engineer

AGRICULTURAL EXTENSION SERVICE

College of Agriculture, University of Wyoming, and U.S. Department of Agriculture Cooperat

April 23, 1980

State Office
Agriculture Buildi
Box 3354, University Statio
Laramie, Wyoming 8207
Phone: (307) 766-33
439

Mr. Lou Allen
State Engineer's Office
Barrett Building
Cheyenne, Wyoming 82002

Dear Lou:

I have reviewed the Soil Conservation Service Big Sandy River-Colorado River Basin Salinity Control Study. The following questions come to my mind as I reviewed the report.

1. No mention is made of the Colorado River Compact. What are the impacts upon the Colorado River Compact for all the alternatives discussed in this Study. Congress is party in both national and/or regional environmental assessments.

2. Page S-2, line 15-16. The statement is made "Most of the salt is thought to be leached ----." "Is thought" tells me that the Study is not sure where the salts are coming from. How can alternative recommendations be made if data is not available to identify the salt source?

3. Page S-2, line 22-23. "On farm practices contribute about 124,000 tons annually ----." Page 1-8. "It is estimated that irrigation contributes 133,300 tons ----" (line 3). The words about-estimated and differences in ton raise questions in my mind. As I remember the Bureau of Reclamation (now WPRS) numbers are even different then those above.

4. Is there a direct relationship between quantities of salt returning to the river and the quantity of return flow water? Or, if the irrigators become more efficient with the water and there is less return flow to the river, does this mean that the salt load will also decrease? I'm not sure this is true. The return flows may be more concentrated and there may not be a substantial decrease in the salt load flowing into the river.

5. Page 1-5, lines 4-5. The estimated crop consumptive use is 1.17 acre-feet per acre used in this report. The University of Wyoming had a research pilot farm on the Eden-Farson Project in the 1960's. The average seasonal irrigation consumptive requirements for that area according to our studies shows for alfalfa 19.55 inches; grass, hay and pasture 18.24 inches and small grain

13.75 inches. The above consumptive requirements are in addition to about 4 inches of effective rainfall. This means according to our figures, the irrigation efficiency figures would be higher then shown in the Study, less return flows, etc. What effect would this have on salt load calculations (reference back to comment 4 above).

6. Have there been any studies made which locate the areas where most of the salt is coming from? It seems the report assumes equal amounts of salt from all the irrigated acres. Is there more salt coming from the high water table area within the irrigation district? How much salt is moving into the irrigated area by natural causes?

7. How much salt will the wildlife habitat areas contribute if installed wetland alternative(s) are slected?

8. Page S-3. The landowner alternative selected to retire 87% of the irrigation on the project should mention right at this point that this was assuming a $2,000 per acre buy-out. People will read this part of the report and never get to the full details later in the report.

9. How can any kind of alternative selections be made before the WPRS has made its studies? Decisions are being made on very limited information which can have a deep impact on the landowners in the area and the community.

10. Has proper attention been given to gravity pressure sprinkler systems? There is enough head from the reservoir to the project lands for such a system. Estimates are that electrical rates will be 13¢ per kilowatt hour by 1990. The cost-benefit ratio may not show feasibility at today's costs but may in a few years (use $2,000 buy-out money for this alternative rather then taking people off the land).

Also, we have studies underway that show acceptable uniformity coefficients of water application with certain sprinkler nozzles at pressures as low as 15 psi. Field studies will continue this summer on new low pressure sprinkler nozzles using sideroll sprinklers.

The above are just some of my concerns and questions. It seems to me that there should be no decisions made or even implied until detailed data has been gathered and properly analyzed. Peoples' lives and futures are dependent upon data that leaves no question to what is now taking place. There is no room for guess work. Oo we really have all the facts?

Sincerely,

Donald J. Brosz
Extension Irrigation Engineer

cc: Dean Harold J. Tuma

WYOMING
EXECUTIVE DEPARTMENT
CHEYENNE

ED HERSCHLER
GOVERNOR

April 28, 1980

Mr. Frank S. Dickson
State Conservationist
Soil Conservation Service
P. O. Box 2440
Casper, WY 82602

Dear Mr. Dickson:

Several state agencies have reviewed the Big Sandy River "on-farm" draft report dealing with the salinity problem in and around Farson, Wyoming. Their comments are attached.

While I recognize that the Soil Conservation Service was restricted to looking at the "on-farm" solutions or alternatives, there are other approaches which may be as effective and may preclude the implementation of any of the SCS alternatives.

One such approach, which is actively being pursued by the state, would be to market the irrigation return flows to industry. This approach may have greater economic and environmental benefits than those proposed by SCS. In any event, a final decision on the Big Sandy should be deferred until the studies to be conducted by the Water and Power Resources Service are completed and other approaches by the state have been explored.

The proposed "federal buy-out" of irrigated land and retirement of land from production could jeopardize other programs which seek to bring land into irrigated production. Therefore, this alternative should not be considered as a viable alternative at this time. Further, I am concerned that this approach has raised the expectations of the landowners in the area for a quick and easy solution to reducing the salinity in the Eden-Farson area.

Additionally, I am formally requesting that the SCS not take any further action on this alternative until the state and the Water and Power Resources Service have had an opportunity to explore other remedies to the salinity problem in the Big Sandy and Green River drainages in Wyoming.

In conclusion, the alternatives discussed in the Big Sandy Report may work, but they should be considered as part of a total salinity control program and not in isolation.

Yours sincerely,

EH/wwt

attachments

cc: The Honorable Malcolm Wallop
The Honorable Richard Cheney
The Honorable Alan K. Simpson

BRUCE BABBITT, GOVERNOR
Arizona Water Commission
222 NORTH CENTRAL AVENUE, SUITE 650
Phoenix, Arizona 85004
TELEPHONE (602) 255-1581

April 28, 1980

Mr. Frank S. Dickson
U. S. Department of Agriculture
Soil Conservation Service
Post Office Box 2440
Casper, Wyoming 82602

Dear Mr. Dickson:

As a member of the Colorado River Salinity Control Advisory Council, I have received, from M. J. Clinton, a copy of the USDA Report, Big Sandy River Unit Salinity Study. He requested that comments be sent directly to you.

The report shows that irrigation in the study area results in the contribution of an estimated 133,300 tons of salt per annum to the river system. Impacts of the Landowner Preferred-Modified Alternative (Alternative 12) would result in a reduction of the salt loading by about 113,000 tons per year, which represents a reduction of 14.3 mg/l at Imperial Dam. The estimated costs of Alternative 12 is about $35.9 million; the annual benefits are about $6.7 million; and the annual equivalent cost per ton of salt reduction is about $24.50. Provided these estimates are reliable, Alternative 12 is one of the most favorable salinity reduction proposals studied to date. It would be less than one-half the cost per mg/l reduction of salinity at Imperial Dam of the stage one development for the Grand Valley Unit.

The Grand Valley evaluations are from a definite plan report, while those in the Big Sandy Report are less detailed. On the other hand, most of the costs of Alternative 12 are land purchase costs, so the Big Sandy estimate should be fairly precise, and perhaps on the high side as cited in the next paragraph.

Alternative 12 has elements of compromise and yet meets the objectives of basinwide salinity control. Most importantly, it

has the apparent support of the majority of local landowners. From a cost and salinity reduction perspective, complete purchase of the Eden Project lands has merit. However, we are very much aware of the environmental and social issues and values and, hence, opt to support implementation of Alternative 12. Although we have no detailed knowledge of irrigated land values, the landowners' request of $2,000 per irrigated acre to retire irrigation seems high.

One final comment. The $5.5 million for structural improvements and $97,000 per annum for O&M&R appears overly burdensome for improving irrigation practices on 2,000 acres of land. The O&M&R cost of almost $50 an acre each year may equal or exceed the crop value at these high elevations. Perhaps a means to keep the 2,000 acres irrigated could be found that would pose less capital and O&M&R costs.

Thank you for the opportunity to comment.

Sincerely,

Thomas C Clark

for Wesley E. Steiner
Executive Director

WES:sw

United States Department of the Interior
WATER AND POWER RESOURCES SERVICE
~~BUREAU OF RECLAMATION~~
UPPER COLORADO REGIONAL OFFICE
P.O. BOX 11568
SALT LAKE CITY, UTAH 84147

IN REPLY
REFER TO: UC-751
452.

APR 29 1980

Mr. Frank S. Dickson
State Conservationist
Soil Conservation Service
P.O. Box 2440
Casper, Wyoming 82602

Dear Mr. Dickson:

Thank you for sending the interagency and public review draft of your Big Sandy River report for our information and review. Our comments are as follows:

General Comments:

Some references to the Bureau of Reclamation in the report should be changed to the Water and Power Resources Service; for example, pages S-1, S-2, and I-3.

Specific Comments:

Page S-2, Line 17 - Change underground rock acquifer to ground water aquifers. There is more than one aquifer.
Line 19 - Change"provide the water" to "provide the mechanism."

Page I-s, Introduction, Line 18 - Change to read to the salinity problem.

Page I-I, Lines 12-13 - Only two wells are known to be in the saline aquifer. The remainder are in the deep fresh water aquifer.

Page I-3, Figure 1-1 - You might want to segregate the drains. Surface water inflow to drains is 13,000 acre-feet. Drain discharge returning to river is 2,775 acre-feet.

Page I-8, Line 8 - Should the 37,700 tons be 32,700 tons?
Line 9 - The saline aquifer is artesian below the irrigated area. Unless all of the artesian head were eliminated the expected reverse flow could not occur.

Page 2-7, Line 15 - The word alternatives is misspelled.

Page 3-4, Line 14 - The excavated potholes would probably increase seepage which could increase salinity.

Page 3-6, Line 6 - Change "a" to "an."

Page 3-22, Line 10 - The storage capacity of 13,440 acre-feet appears too low. Is this the annual pumpage?

Page 3-24, Figure 3-1 - Refuge is misspelled.

Page 3-26, Line 19 - Should say the project efficiency decreased from 32 percent to 20 percent.

Page 4-6, Line 3 - Big Sandy water at 6,000 ppm is not highly saline.

Page A-6, Lines 9, 12, and 14 - Replace the word "in" with "by" to show that construction was completed by these dates.

Page A-8, Line 11 - Revise to say that a test well was drilled rather than an observation well.

Page A-15, Line 18 - Suggest gravel be deleted. There is very little gravel on the Eden Project.

Sincerely yours,

F. Phillip Shamp

for W. Plummer
Regional Director

UNITED STATES DEPARTMENT OF AGRICULTURE
FOREST SERVICE
Rocky Mountain Region
11177 West Eighth Avenue, Box 25127
Lakewood, Colorado 80225

3520

April 9,1980

Frank S. Dickson
State Conservationist
P.O. Box 2440
Casper, Wyoming
82602

Dear Frank:

We have no comments on the March 1980 Review Draft of the Big Sandy River Salinity Control Study for the Colorado River Basin.

The study area, including the 182,000 acres of National Forest land, lies outside our jurisdiction. Forest Service, Region 4, has responsibilities in western Wyoming and can be contacted at:

Federal Building
324 25th Street
Ogden, Utah
84401

Sincerely,

for DAVID A. ANDERSON
Director
Land Management & Program Planning

Enclosure

Frank S. Dickson
State Conservationist
Soil Conservation Service
P. O. Box 2440
Casper, WY 82602

Dear Mr. Dickson:

We would like you to include our comments with the final Big Sandy Report. We operate a family farm with a loose knit partnership arrangement. Each member works as hard as he can and gets by on as little as possible. Even though we are one of the larger landowners in the Eden Valley Irrigation District, we are still not able to make a living from farming alone.

The Big Sandy River runs through our ranch so we can see first hand the huge amounts of water that goes on the land and then eventually seeps back into the river. We irrigate to the best of our ability to control this water return. We use fifteen inch turnouts and irrigate as rapidly as possible. One of us is with the water at all times on an around the clock basis.

Our fields and ditches are in very good shape and we use the border method to flood irrigate our crops. The soil is so porous, and also so cracked from winter freezing, that the first irrigation each year takes between nine and twelve inches of water to irrigate the first time over.

The ASCS and we have both spent many thousands of dollars to improve our irrigation system. We have installed large drop structures, leveled land, put in large turnouts and improved our ditches. With all of these improvements, it has still not helped control the salt water from returning to the river.

We believe the only method that could be used in this Valley that would control the salt in the river would be by using a sprinkler system. If someone gave us the sprinklers and replaced them as they wore out we still could not afford to use them. Our crops are too small and limited and the growing season is too short for us to pay for the operating costs of the sprinklers.

When we consider the vast amount of money that it would take to install, maintain and operate a sprinkler system, along with the small returns from our crops, we feel the best way to stop the salt problem in this valley is to quit irrigating.

We sincerely request that something be done with this report as soon as possible. It is very difficult to make plans and operate our farm with this study and all the publicity about the salt hanging over our heads. This situation is impossible to live with and is hurting us seriously financially.

Yours truly,

Marvin N. Applequist I Marvin N Applequist I
Marvin N. Applequist II Marvin N. Applequist II
Peter Applequist Peter P Applequist
Farson, WY 82932

P. O. Box 27
Eden, WY 82926
April 30, 1980

Mr. Frank J. Dickson
State Conservationist
Soil Conservation Service
P. O. Box 2440
Casper, WY 82602

Dear Sir:

For approximately one month we have been trying to be open minded in our study of the Big Sandy River/Colorado River Basin Salinity Control Study.

However, we keep referring to the fact that the overwhelming 76% vote for Alternative 8, is in reality 76% or 56% (page B-1). Hopefully this is because we are completely against any drastic damage (land or water retirement) in this area.

We note on each of the alternatives a notable salinity reduction at Green River that results in a very minor reduction at Imperial Dam (see chart enclosed). This makes it appear that great sums of money can be spent to reduce salinity in the Big Sandy River. However, thesalinity seems to increase as the waters travel downstream and arrive at Imperial Dam. Our logic would conclude, perhaps a large desalinization plant just above Imperial Dam is the real answer to the problem.

Basically, we are stating again that our lives have been built in this area, hopefully improving our farm, and we wish to continue this life style. Perhaps someday our son will want to continue operating the family farm unit. Therefore, we again request consideration for the existing agricultural community in remembering that inflation alone is difficult enough to cope with; so please exert all caution to help us continue without adding additional expenses to our operations that will force us out of business.

Recently many publications and news articles have presented the various types of pollution that directly or indirectly result from the raising of crops and livestock. If we all cease farming and polluting a lot of people will also have to stop eating!

Sincerely,

Justyne Tomich

Mrs. Edwin (Justyne) Tomich

Copies:
Sen. Simpson & Wallop
Rep. Cheney & Gov. Herschler

ALTERNATIVE #	*SALT REDUCTION AT GREEN RIVER WY mg/l	*SALT REDUCTION IMPERIAL DAM mg/l	REDUCTION LOSS FROM G.R. TO IMP. mg/l
2	1.20	.20	1.0
3	49.37	10.53	38.84
3A	26.67	5.49	21.18
3B	26.67	5.49	21.18
4	21.63	4.54	17.09
5	24.34	5.09	19.25
6	67.4	16.04	51.36
8	67.4	16.04	51.36
9	21.63 7.81	4.54 2.20	17.09 5.61
10	38.55	6.92	31.63
11	39.25	9.69	29.56
12	60.92	14.30	46.62
EQA	41.57	8.18	33.39

*Figures taken from list of Alternative in Big Sandy River/ Colorado River Basin Salinity Report.

Box 46
Farson, Wyo.
Apr. 30, 1980

Mr. Frank Dickson
State Conservationist
Casper, Wyoming

Dear Frank;

I have read the Big Sandy Salinity Study, and find my biggest concern is the uncertainty that the people of Eden Valley must face. There is no easy solution to the problem.

Either irrigation retirement or sprinklers are the only alternatives that I feel would have very much affect on salinity reduction. Automatic borders on our porous soil probably wouldn't be feasible to farm as the length of runs would have to be less than 500 ft. and with topsoil a minimum anyway the leveling needed wouldn't leave any topsoil in many places.

With energy costs the way they are now, it would take a healthy cost sharing program on Operation and Maintainance for the farmers to be able to justify them.

If land retirement is the option taken I feel a provision should be made to consider the sale an involuntary conversion and the people be given 2 to 3 years to relocate.

The time for a decision is now. It is almost impossible to get enthused about improving your place if you don't know if anyone will farm it in the future. I feel this study has devalued our land. It has made it hard for people that need to sell, for various reasons, to do so.

I know there is no easy solution to the problem but it is time to do something or decide to live with the problem as it is.

Sincerely,

James Hadden

Frank S. Dickson
State Conservationist
Soil Conservation Service
P. O. Box 2440
Casper, WY 82602

Dear Mr. Dickson:

In response to the Big Sandy River report of the Colorado River Basin Salinity control study, the following are our comments.

After reviewing all statements, comments and research at all public meetings and the above mentioned publication, it is readily apparent that the only feasible solution is one of the three alternatives that retire irrigation practices. Namely 6, 8 or 12.

These are the only sensible alternatives as the cost-benefit ratio is very favorable. They achieve maximum salt loading reduction while giving a relatively small number of people the opportunity to relocate their operations. This is preferable to all other alternatives as the remaining alternatives will increase landowner debt, reduce available water, be energy inefficient, very costly and not achieve significant salt reduction. We also feel that these three alternatives are very definite and final. There would not be any need to look at it again in five or ten years.

This study and the publicity it has received has put the agricultural community in the Eden Valley Irrigation District in a very untenable position. At the present time our land is valueless with this proposal over us. We are unable to expand or make major improvements as money is not available to some of us due to this study. It is imperative that this matter be resolved in the very near future. No community needs the problems this study has brought on us.

Concerning the proposed figures mentioned in the study for land or water purchases, we question how much research has gone into these figures and we feel they should be reviewed with the landowners.

phosphates and other polution, mainly animal wastes from our fields which the DEQ study blamed heavily on the Eden Project. The State of Wyoming made this study and, at a meeting attended by me (W. L. Harns) in Green River three years ago, the statement was made that the only place they could really do any cleaning up of the river was by controlling run-off from the Eden Project. Why not consider removing this hazard of polution of the Green River by applying the irrigation retirement alternatives. We do not feel we want to be harassed by this agency and then another and another from now on.

Yours truly,

Aaron Neale Jones, Farmer

Aaron Neale Jones

William Lee Harns, Farmer

William Lee Harns

cc:

Malcom Wallop, U.S. Senator
Alan Simpson, U.S. Senator
Dick Cheney, Member of Congress

STATE OF CALIFORNIA—THE RESOURCES AGENCY EDMUND G. BROWN JR., Governor

COLORADO RIVER BOARD OF CALIFORNIA
107 SOUTH BROADWAY, ROOM 8103
LOS ANGELES, CALIFORNIA 90012
(213) 620-4480

May 2, 1980

Mr. Frank S. Dickson
USDA - Soil Conservation Service
Post Office Box 2440
Casper, Wyoming 82602

Dear Mr. Dickson:

We have reviewed the draft U.S. Department of Agriculture Report, "Big Sandy River - Colorado River Basin Salinity Control Study", March 1980.

The report presents a number of alternatives for salinity control, most are very cost-effective. We support all cost-effective solutions to the salinity problems in the Colorado River Basin. One alternative, Landowner Preferred - Modified has the support of the local citizens, an extremely important element in the successful implementation of salinity control activities. However, this alternate leaves some 2,000 acres in production for which irrigation systems improvements are proposed. Continued efforts should made to reduce the costs of salinity control on that acreage, as the estimated cost per acre for salinity control is $3,425 per acre as compared to $2,000 per acre for land retirement.

We have some specific comments on the report which are as follows:

Page I-2, Figure 1-1. The irrigated areas should be shown on this figure.

Page I-6, lines 1 and 2. Identify the location of the "Big Bend" area.

Page I-7, lines 7 thru 9. This paragraph implies that ASCS cost-share funds are available once the project is approved. This is not the case. To the best of my understanding, USDA has not included funds for on-farm salinity control activities in its current budget and it has only been through the efforts of the Colorado River Basin states in Congress that funds have been earmarked for on-farm cost-share salinity control activities in the Colorado River Basin. This misconception regarding the availability of funding should be clarified.

Page 1-8, lines 4 thru 9. It is unclear how the mechanism described for increased salt loading takes place. Is the value 32,700 tons or 37,700 tons?

THE STATE OF WYOMING

ED HERSCHLER
GOVERNOR

Game and Fish Department

CHEYENNE, WYOMING 82002

EARL M. THOMAS
DIRECTOR

May 9, 1980

EIS 484 Colorado River Basin
Salinity Control Study
Big Sandy River
USDA/SCS/Report

Mr. Frank S. Dickson
State Conservationist
USDA Soil Conservation Service
P.O. Box 2440
Casper, Wyoming 82602

Dear Mr. Dickson:

Our review of the subject study report revealed only one error that we feel needs correction.

Page A-27, line 25, states that the reservoir maintains "populations of rainbow and brown trout." This should be changed to reflect that brown trout is the dominant species, cutthroat trout are present in much lower numbers, and rainbow trout are only incidental in occurrence.

Thank you for the opportunity to review this report.

Sincerely,

W. DONALD DEXTER, ASSISTANT DIRECTOR
WYOMING GAME AND FISH DEPARTMENT

cc: Game Division
Fish Division

WDD:HBM:ag

Advisory Council On Historic Preservation

ADVISORY COUNCIL ON HISTORIC PRESERVATION
LAKE PLAZA-SOUTH
SUITE 616
44 UNION BLVD.
LAKEWOOD, COLORADO 80228

1522 K Street N.W.
Washington D.C.
20005

April 4, 1980

Mr. Frank S. Dickson
State Conservationist
Soil Conservation Service
P. O. Box 2440
Casper, Wyoming 82602

Dear Mr. Dickson:

Thank you for your request of March 20, 1980, for comments on the draft environmental statement (DES) for the Soil Conservation Service's (SCS) Big Sandy River Salinity Report, Wyoming. Pursuant to Section 102(2)(C) of the National Environmental Policy Act of 1969 and the Council's regulations, "Protection of Historic and Cultural Properties" (36 CFR Part 800), the Council has determined that this DES does not demonstrate compliance with Section 106 of the National Historic Preservation Act of 1966 (16 U.S.C. Sec. 470f, as amended, 90 Stat. 1320) in accordance with the Council's regulations. However, it appears that the SCS recognizes its responsibility pursuant to Section 106, as amended, and will carry it out in the future. The Council looks forward to working with SCS in accordance with the regulations, as appropriate.

We have been able to retain additional staff to assist Federal agencies with their compliance responsibilities for water resource and related projects. Should you have any questions or need assistance, please contact Betty LeFree of the Council's Western Division of Project Review at (303) 234-4946, an FTS number.

Sincerely,

Louis S. Wall
Chief, Western Division
of Project Review

United States Department of the Interior
HERITAGE CONSERVATION AND RECREATION SERVICE
INTERAGENCY ARCHEOLOGICAL SERVICES—DENVER
P.O. BOX 25387, DENVER FEDERAL CENTER
DENVER, COLORADO 80225

IN REPLY REFER TO:

1201-05 (W530)

MAR 28 1980

Mr. Frank S. Dickson
State Conservationist
Soil Conservationist
P. O. Box 2440
Casper, Wyoming 82602

Dear Mr. Dickson:

Thank you for providing us with a copy of the Interagency and Public Review Draft of the Big Sandy Salinity Study Report. Any comment we might have will be coordinated through the Manager of Environmental Programs, Mid-Continental Regional Office, Heritage Conservation and Recreation Service.

Sincerely yours,

Jack R Rudy
Chief, Interagency
Archeological Services - Denver

Discussion and Disposition of Each Comment on Interagency and Public Review Draft Report

FISH AND WILDLIFE SERVICE

Comment: The report cites the American peregrine falcon, bald eagle, and black-footed ferret as endangered wildlife species possibly occurring in the project area. Selection of an alternative or combination of alternatives for further action and preparation of an EIS should include a biological assessment of project effects on these species are required by the Endangered Species Act Amendments of 1978. If it is determined they may be affected, formal consultation must be requested from the Fish and Wildlife Service. Since several endangered species of fishes occur downstream in the Colorado River system, the effects on them should also be considered. Prior to the development of your biological assessment under Section 7, a list of endangered, threatened, and species proposed for listing that may occur in the project area should be requested from the Regional Director, Fish and Wildlife Service.

Response: Page 4-7 states that formal consultation will be requested prior to the implementation of any plan.

Effects downstream are generally addressed by the program EIS (see pages 2-2 and 4-7). A supplement to the program EIS may be prepared, if required to address more specific local impacts.

MASON E. HEATHMAN

Comment: Now, as far as I am concerned the government can do one or two things, either buy me out or leave me alone.

Response: SCS is not recommending a particular alternative. Legislative action will be necessary to implement any of the salinity reduction alternatives that have been evaluated.

STATE HISTORIC PRESERVATION OFFICER

Comments: The study outlines several alternatives to reduce and control the salinity of the Big Sandy and Colorado Rivers. Although no specific geographic areas are outlined, those portions subject to surface modifications when determined, should be reviewed for their potential impact upon cultural resources.

A cultural resource inventory of all of the proposed structural measures areas is recommended prior to initiation of any construction.

Response: The need for a cultural resources inventory is recognized and the procedure to be followed is discussed on pages 4-7 and 4-8. This is also reemphasized on page S-3.

WYOMING DEPARTMENT OF AGRICULTURE

Comment: (1) The salinity on the Big Sandy Project is natural and man caused and should be approached in that manner and a program designed to control salinity whenever possible.

Response: We agree.

Comment: (2) The Wyoming Game and Fish Department and the U.S. Fish and Wildlife Service should be required to contract for and reimburse the project irrigators to a fair and equitable price for committed project or excessive waters that are released on a scheduled basis to improve downstream fish or wildlife habitat. This type of action would provide a portion of the mitigation requirements to the irrigator for the loss of water for agricultural use.

Response: We cannot make this a requirement.

Comment: (3) The two federal agencies who are making the study (USDA-Soil Cnnservation Service, and the USDI-Water and Power Resources Serivce), should coordinate their studies with the State of Wyoming and develop the best solutions or alternatives possible to control the salinity from the project as well as natural causes.

Response: We agree.

Comment: (4) The landowners and renters on the project should be given the opportunity to work with the federal and state agencies in developing a water and land management system that will allow them to continue their agricultural practices, but also assist in reducing the salinity problems created by man and natural causes in the Big Sandy drainage area.

Response: We believe the landowners and renters were given this opportunity and have used it to express their desires in this report.

Comment: (5) If there is money available through the Colorado River Salinity Control Act to help control salinity those funds should he used to do remedial work on the Eden-Farson Project at no cost to the owners.

Response: The Act does not provide funding; however, funds may be appropriated to do this.

Comment: (6) Grants and low interest rates for money needs based upon the economic feasibility of various programs should be made available to the people on the project so they could and would install the various conservation practices that would provide better land management, water management, energy saving, labor requirements and provide greater crop and livestock yields, as well as, help prevent and control the Big Sandy Salinity cause.

Response: We agree.

Comment: (7) A thorough study should be conducted as to the feasibility of converting the present irrigation system on the project from flood irrigation to gravity sprinkler irrigation both high and low pressure.

Response: There is not adequate elevation between the reservoirs and the farmland to supply gravity pressure for either high or low pressure sprinkler irrigation (see page 3-3, Alternative 3).

Comment: (8) Owners and operators on the project should be involved with the studies and be kept abreast of federal and state action.

Response: We agree and have tried to accomplish this.

WYOMING DEPARTMENT OF ENVIRONMENTAL QUALITY

Comment: (1) Page S-2, line 14. It is indicated that the Big Sandy River is contributing 149,200 tons per year of salt for the period 1960 through 1977. This figure is adjusted to 157,600 tons per year later in the report. The 208 Plan, "Clean Water Report for Southwestern Wyoming" indicates that the loading for the period 1970-75 was approximately 270,000 tons per year (page 5-5). Can the difference in these loadings be accounted for due to differences in annual runoff or is ther a basic difference in estimating the salt loading?

Response: The figure 157,600 tons per year of salt is the estimated present and future conditions without-project value. According to the "Clean Water Report for Southwestern Wyoming" Final Technical Report, August 1978, only the years 1975 and 1976 were used in their analysis to show a salt loading of 270,000 tons per year. The differences between that report and our study is in the difference of annual runoff and in the method of evaluation. SCS considered the effects of varying daily flow between the sample dates. The Clean Water Report for Southwestern Wyoming did not (see page 5-5 of the "Clean Water Report").

Comment: (2) Page S-5, Table S-1. The table shows the salt loading reduction equal for the land retirement and irrigation retirement alternatives. This does not appear realistic in that grazing activities would undoubtedly increase erosion and salinity loading to some degree.

Response: We agree, but believe the effect of surface runoff and salt loading would be insignificant when compared to the salt loading created by irrigation on the area.

Comment (3): Page I-5, line 17. Statement is made that the Big Sandy Reservoir does not contribute significantly to saline aquifer problem. This does not appear to be consistent with the 208 Management Plan (see page 5-46) which indicates that water resource development within the contact zone will contribute significantly to salt loading. Directly or indirectly through irrigation the reservoir is a significant source of salinity loading.

Response: Indirectly, the reservoir contributes to the salinity, because without the reservoir most of the irrigation would not be possible. However, the tests by WPRS have shown that seepage from the reservoir returns to the stream immediately below the dam and at relatively good quality and does not contribute significantly to the saline aquifer problem.

Comment (4): Page 1-1, line 20. See comment #1, relative to average annual salt loading. This comment also applies to other sections of the report where salt loading is referred to.

Response: The value of 149,200 tons per year is supported with substantial calculations and is believed to be the most accurate figure available. The annual values shown in Table 1-2 also compare favorably with those reported by the U.S. Geological Survey (DeLong 1977) for a shorter period of time.

Comment (5): Page 4-3, line 27. It is indicated that landowners desire to retain ownership and all mineral rights if the irrigation retirement alternative is implemented. The 208 Plan identifies certain sensative areas where construction, surface mining, and drilling activities will significantly increase salinity loading. If such activities replace irrigation salinity loadings should be adjusted accordingly and reflected in the economic analysis of the alternative being evaluated.

Response: This study does not address the effects or impacts of other activities which may or may not occur independent of the salinity control program. Such activities should be evaluated on their own, if and when they are proposed. Refer to page 4-4.

WYOMING WATER DEVELOPMENT COMMISSION

Comment: My comments relate to what I feel is a neglect of at least one other alternative to reduce salt loading problems in the Big Sandy area. It has been suggested at the state level, and very preliminarily reviewed, that gravity flow sprinkler irrigation or siderolls, by itself or in combination with a sprinkler system powered by a pump, might be possible. Is the drop

in elevation from Big Sandy Reservoir to irrigable land in Eden and Farson projects sufficient to allow gravity flow? The study does not even address this option--no evidence is supplied to indicate this was even considered and/or rejected.

Response: The report states on page 3-3 how the development of this alternative occurred and why 6,400 HP is required to provide pressure to operate a sprinkler system.

Comment: (1) I am not sure how SCS arrived at the figures for salt loading reduction. For example, in connection with Alternative 3 (sprinkler irrigation), p. 3-7, figures are provided showing a salt loading reduction to 61,300 tons per year. How are these figures arrived at? Methodology is non-existent. It is my opinion that to know how figures are arrived at is as important as the actual figures.

(2) Moreover, the heart of my complaint with regard to methodology also appies to how beneficial and adverse effects are arrived at. For example, what basis is used for determining downstream benefits?

Response: (1) Developing the methodology for salt loading reduction was accomplished by evaluating on a year by year basis the 1960 through 1977 historic flow and water quality records. This was done at various USGS gages throughout the Big Sandy River Watershed. In addition, all individual water quality spot sampling data was evaluated.

Equations were developed from the historic data, showing a relationship between return flow volume at various locations along the Big Sandy River and water quality of those return flows. After this relationship had been established each alternative was evaluated in terms of irrigation efficiency and resulting deep percolation which in turn returns to the Big Sandy River. This provided the basis for tonage reduction of salt for each alternative shown in the report.

(2) The basis for determination of the impact of salt reduction in the Big Sandy River to salt concentrations mg/l at Imperial Dam is as follows:

> Using the historic record of water flow and water quality for the 1941-1976 period a "Present Condition 1976" was established. This base established flow and salt concentration at Parker Dam on the Colorado River. The water and salt impact of each Big Sandy Salinity reduction alternative was routed

to Parker Dam on a one to one basis. At this point a constant volume of water is diverted from the Colorado River system. The remaining flow is then routed to Imperial Dam and a new salt concentration is computed. The revised salt concentration at Imperial Dam is then compared against the "Present Modified Condition 1976" base of 1046.36 mg/l.

The benefits of each mg/l change at Imperial Dam have been established by a consortium of Water Resources Centers in the States of Arizona, California, Colorado, and Utah, in a publication called "Salinity Management Options for the Colorado River--damage estimates and control program impacts". The 1979 value set an annual benefit of $416,000 for each mg/l change at Imperial Dam. These salinity reduction benefits are derived from municipal and agricultural impacts.

The downstream salinity reduction benefits of $12,495 per mg/l change in the Green River at Green River, Wyoming have been established by interviews with Trona Plants, City of Rock Springs and Green River and the Jim Bridger Power Plant. As salinity concentrations are reduced water treatment costs are also reduced. In addition, less water is required in the power plant as it can be recycled more times. These factors and others were used to develop the value of each mg/l change in the Green River in Wyoming.

Comment: (1) Obviously, if I were a landowner, I would prefer selling my lands for $2,000 an acre (p. 3-27). Compensation for a landowner takes various forms and is in Alternatives 6 (land retirement); 8 (irrigation retirement); 11 (landowner preferred); 12 (landowner preferred-modified). Is the figure of $2,000 on p. 3-27 per acre market value? If not, would not federal regulations prohibit compensation above market value? If this is the case, the landowner preferred option strikes me as a window-dressing alternative, designed to appease landowners with no legal or administrative foundation. Conceptually, I feel that compensation for land provides the purest form in solving the salt loading problem. However, I really don't know the administrative and legal details which would be necessary to implement Alternative 11. Nor is there an examination of the policy considerations, if any, of taking irrigable agriculture out of production in Wyoming.

Response: The figure of $2,000 per irrigated acre was not used in Alternative 6 or Alternative 8. An economic evaluation

was made on each of these alternatives using present appraisal value of all the items that were required in each alternative.

The figure of $2,000 per irrigated acre was used in Alternatives 11 and 12 at the request of the landowners. Congressional action would be required to set any figure other than appraisal.

STATE ENGINEER'S OFFICE

Comment: (1) Page I-4, lines 20-22. We object to any alternative being "selected for implementation" at this time. Such action is premature, and should not be taken until WPRS and State efforts are completed and an informal decision can be made by all concerned.

Response: The sentence has been deleted.

Comment: (2) Page 2-6, lines 16-18. Did the Coordinating Committee or the SCS send out the summary and questionnaire? This Committee member did not see the final questionnaire until it had been sent to him from the SCS office in Casper.

Response: The SCS sent the summary and questionnaire to the State Engineer's office at the request of the Local Coordinating Committee members. The Coordinating Committee sent the questionnaire to the landowners.

Comment: (3) Page 3-1, lines 24-25 and subsequent pages. I fail to see the practicality of drying up a wetland in one area in the name of conserving water, and then incurring costs for construction and maintenance to replace it in another area, with its attendant water losses.

Response: The mitigation to which you refer does not create additional wetland. It only improves the remaining wetland areas. Cost has been included in the mitigation plan to reduce wetland seepage.

Comment: (4) Page 3-1, lines 25-27 and page 3-2, lines 1-2, and elsewhere. This refers to water not utilized for irrigation due to increased irrigation efficiencies, and used for instream flows on a scheduled basis. There may be some question as to how this would be accomplished. Also, if this could be done, are the Wyoming Game and Fish Department and/or the Fish and Wildlife Service willing to pay their portion of storage and O&M costs in order to share in the unused project water on a scheduled basis? If this water could be put to legally defined beneficial uses and delivered downstream on the users' schedules, the fish could certainly use it as available.

Response: The line following the lines to which you refer explains that actual releases would need to be worked out on an annual basis. SCS cannot speak for these agencies on

to Parker Dam on a one to one basis. At this point a constant volume of water is diverted from the Colorado River system. The remaining flow is then routed to Imperial Dam and a new salt concentration is computed. The revised salt concentration at Imperial Dam is then compared against the "Present Modified Condition 1976" base of 1046.36 mg/l.

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Response: The figure of $2,000 per irrigated acre was not used in Alternative 6 or Alternative 8. An economic evaluation

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STATE ENGINEER'S OFFICE

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Response: The line following the lines to which you refer explains that actual releases would need to be worked out on an annual basis. SCS cannot speak for these agencies on

their willingness to pay, and has only shown the most desirable releases from a fisheries viewpoint when there is excess water in the reservoirs.

Comment: (5) Page 3-15, Alternative 6 - Land Retirement. Lines 3-16 on page 3-16 make the wording more acceptable than previous forms, but it still carries the same message and the buy out concept is still not acceptable. The question of who will own the reservoirs and the storage space in the event such a scheme did come to pass is not addressed. The question of water rights ownership is also left in limbo.

The Economic Display on page 3-16 fails to show adverse effects to the State economy from foregone production, lost taxes, and the loss of cash flow from the project.

Response: Ownership of the reservoirs would probably be left to the disposal of the implementing agency. The water would presumably be put to beneficial use elsewhere in Wyoming. The effects of that action on salinity would be addressed at that time. It is our understanding that the State of Wyoming would have control over the abandoned water rights.

The adverse effects to the State of Wyoming for Alternative 6 are shown in the Regional Development Account on Figure C-5 on page C-6.

Comment: (6) Page 3-17, Alternative 8 - Irrigation Retirement. The comments here are essentially the same as for Alternative 6, above.

Response: So are the responses.

Comment: (7) Page 3-20, Alternative 9. This alternative proposes to limit the landowner to 2.0 acre-feet of water per acre. Who is proposed to regulate this use? This must be voluntary action on the part of the landowners, as they have rights for the use of this water.

Response: The first paragraph describing Alternative 9, describes this as a voluntary action. Regulations would be provided by the implementing agency.

Comment: (8) Page 3-22, Alternative 10. This alternative proposes pumping saline water to Sublettes Flat for evaporation. This action would waste Wyoming's compact water, as well as waste the energy required to pump the water. This is not an on-farm salinity problem, but since it is addressed, [illegible] pumping to an industrial use in conjunction [illegible]oir water? How long would it take for [illegible] salinity of the evaporation pond to approach that found in the trona plant evaporation ponds, which are claimed to be hazardous to waterfowl?

Response: Should a user of the saline water be found after this alternative has been implemented, it would be very

easy to provide the required water at the wells or pumping stations. The only impact on the evaporation reservoir would be a reduction in size.

The evaporation pond salinity can be controlled by use of dikes. The more saline waters will be acceptable as long as some relatively fresh water is available.

Comment (9): Page 3-25, Alternative 11 - Landowner Preferred. In line 7, the location of the 2,000 acres that would continue to be irrigated would have some effect on several factors distribution costs and efficiency, deep percolation, and the farming efficiency. The land remaining in irrigation may not be the most desirable from the standpoints of irrigation efficiency, production, and salt loading reduction.

The information in the footnote on page 3-27 needs to be more explicit that the $2,000 per irrigated acre price is the price desired by the landowners. This information should be in the text on page 3-25, and should also be on page 3-15 (Alternative 6). This price, or a corresponding one, should also be shown on page 3-17 (Alternative 8). There should be emphasis that this desired price would be subject to an appraisal by the purchasing agency and that the resulting figure would very likely be much lower. See Comment Number 12 also.

Response: We agree, however for the purposes of this report we used average values in analyzing the effects.

The wording of the footnote was revised. (Page 3-16). Further discussion on this matter is in Chapter 4.

Comment (10): Page 3-28, Alternative 12 - Landowner Preferred-Modified. Comment Number 9 would apply to this alternative also.

Response: The footnote (Page 3-17) was also changed.

Comment (11): Page 3-35, Item D.2 under the EQ Account. Changing cropland to rangeland is not an irreversible or irretrievable commitment of resources. This also applies to the same item on page 3-36. Under the Social Well-Being Account, B.1 and 2, who would benefit from any improved hunting and fishing, and what about public access to any improved hunting and fishing? See these same items on pages 3-36 and 3-37, also.

Response: These land use changes are not irreversible or irretrievable; and have been moved to the biological resources and selected ecosystem section. Those people who chose to hunt and fish in the area would benefit from the improved conditions. These would be expected to be mostly Wyoming residents. On public lands access would be available to all persons.

Comment (12): Page 4-3, lines 8-27. Alternative 6, Land Retirement, shows a desired buy out price of $2,000 per irrigated acre. Alternative 8, Irrigation Retirement, shows this same desired price, but the landowners would remain. This does not appear

to be reasonable. In lines 15-20, a cost of about $1,300 per irrigated acre is estimated as a break-even price - indicating the landowers are requesting a windfall profit of around $700 per irrigated acre, even though they are asking to be bought out. In lines 23-27, and lines 1-4 on page 4-4, the break-even price for irrigation retirement is given as approximately $1,400 per irrigated acre. This is a $600 per irrigated acre windfall profit with the landowners desired $2,000 per irrigated acre price, and the landowners would still retain their land and mineral rights while having hay provided for their livestock. Refer to Comment Number 20, also.

Response: The figure of $2,000 per irrigated acre was not used in the evaluation of Alternative 6 - Land Retirement or Alternative 8 - Irrigation Retirement. Alternative 6 used a cost of approximately $1,300 per acre and Alternative 8 used $1,400 per acre.

We believe the per acre price used in our evaluation is reasonable when cosidering the benefits obtained. It is unrealistic to expect people to relocate from their homes without some financial inducement.

Comment: (13) Page 4-4, lines 16-17. ". . . the salinity reduction benefits are far in excess of the costs." This and similar statements in the report are based on a false premise. Salinity concentration reduction through leaving more water in the stream as it leaves the project area presumes that this water arrives at Imperial Oam undiminished in quantity. We would expect most of this water to be utilized before it reaches Imperial Dam - some in Wyoming and much of it before it escapes the Upper Basin. The salinity concentration reduction benefits to Wyoming would not meet the costs, and the benefits to downstream users would in actuality be much less than those postulated in the report. See also, page 4-10, lines 6-25.

Response: It is presumed that the quantity of water not used by the project will arrive at Parker Dam, not Imperial Dam. While this may not in fact be true, it will be the responsibility of the downstream user to show the effects of using that water on the salinity. If an alternative use of the water were considered, benefits may be greater. Most of the salinity reduction is due to a decrease in salt loading, not an increase in downstream flow. Even if the water is consumed elsewhere, as in Alternative 10, most of the benefits will be realized.

The Regional Development Accounts (Figures 3-2, 3-3, and 3-4) show that benefits to Wyoming exceed the cost to Wyoming.

Comment: (14) Page 4-5, lines 12-13. If it was not the intent of the study to determine what uses the water not needed for irrigation may have, why has so much space and effort been devoted to designating it for instream flows, evaporation, and wetlands?

Response: Increased instream flow, evaporation, and wetland uses may be thought of as alternatives to water development. They were considered as environmentally desirable.

Comment (15): Page 4-5, lines 25-27, and page 4-6, lines 1-5. There should be mention of the potential for industrial use of the Big Sandy water as a preferred alternative to wasting it to evaporation on Sublettes Flat.

Response: Industrial uses of saline water have not previously been justified due to high treatment costs.

Comment (16): Page 4-6, lines 9-17. The uncertainty expressed in lines 9-17 negates the specifics discussed in such a positive manner in the Landowner Preferred-Modified Alternative section which follows this paragraph.

Response: The uncertainty is in regard to funding and the implementing agency If properly funded, it is expected that the Landowner Preferred-Modified Alternative would continue to be the choice of the local people.

Comment (17): Page 4-10, line 1, "Negotiable". Everywhere else in the report, the $2,000 per irrigated acre figure is referred to as the landowners' price with no intimation of negotiation, and all of the SCS computations are based on this $2,000 figure where retirement of either land or irrigation is involved.

Response: It has been indicated to us that a figure of less than $2,000 per irrigated acre would not be "negotiable" or "acceptable".

The $2,000 per acre figure was used only in Alternative 11 and Alternative 12. An economic evaluation was made on Alternative 6 and Alternative 8. See response to comment (12).

Comment (18): Chapter 4. The entire discussion in Chapter 4 seems oriented to the presumption that the SCS on-farm study is the final study action, rather than a small part of the WPRS Colorado River Basin salinity control program. The several alternatives envolved in the SCS study need to be evaluated along with the WPRS Big Sandy Unit results and with the efforts of the State for developing industrial uses for the water from the Big Sandy River.

Response: The relationship to projects and programs of other agencies is discussed in the Introduction and in Chapter 2.

Comment (19): Appendix A, Page A-12, lines 11-17. In view of this paragraph, why is there so much supposed interest from the landowners in selling out?

Response: It is not the intent of this report to speculate. The views of some of the landowners are shown in this section, in their reponses.

Comment (20): Appendix B, Page B-1, lines 23-26. Compare the "needed" $2,000 per irrigated acre (line 24) with the figures on sheet E of Appendix B. Alternative 6 estimates the value of land at $1,238 per irrigated acre. Again, computations - and expectations - based on a price of $2,000 per irrigated acre do not appear to be realistic.

Response: Refer to Response No. 12.

AGRICULTURAL EXTENSION SERVICE

Comment: (1) No mention is made of the Colorado River Compact. What are the impacts upon the Colorado River Compact for all the alternatives discussed in this Study. Congress is party in both national and/or regional environmental assessments.

Response: The Colorado River Compact allocates water among the various states in the Colorado River Basin. The alternatives presented would not affect the Compact. Those alternatives that utilize more water are still within Wyoming's share of the Compact. Those alternatives that use less water would allow that water to be used elsewhere in Wyoming.

Comment: (2) Page S-2, line 15-16. The statement is made "Most of the salt is thought to be leached . . . .". "Is thought" tells me that the Study is not sure where the salts are coming from. How can alternative recommendations be made if data is not available to identify the salt source?

Response: This sentence has been reworded.

Comment: (3) Page S-2, lines 22-23. "On-farm practices contribute about 124,000 tons annually . . . .". "It is estimated that irrigation contributes 133,300 tons . . . ." (line 3). The words about-estimated and differences in ton raise questions in my mind. As I remember the Bureau of Reclamation (now WPRS) numbers are even different than those above.

Response: The 124,900 tons referred to on page S-2 was the average for the period 1960-1977. Words were added to clarify this. The 133,300 tons is the estimated present and projected without-project average tonage used in the evaluation.

Comment: (4) Is there a direct relationship between quantities of salt returning to the river and the quantity of return flow water? Or, if the irrigators become more efficient with the water and there is less return flow to the river, does this mean that the salt load will also decrease? I'm not sure this is true. The return flows may be more concentrated and there may not be a substantial decrease in the salt load flowing into the river.

Response: The concentrating of salt in the return flow will increase with a decrease in volume of flow. This was studied in considerable detail and the estimates made of salt load reduction are based on this relationship.

1 and 2 from Wyoming Water Development

Comment: (5) Page 1-5, lines 4-5. The estimated crop consumption is 1.17 acre-feet per acre used in this report. The University of Wyoming had a research pilot farm on the Eden-Farson Project

in the 1960's. The average seasonal irrigation consumptive requirements for that area according to our studies show for alfalfa 19.55 inches; grass, hay and pasture 18.24 inches, and small grain 13.75 inches. The above consumptive requirements are in addition to about 4 inches of effective rainfall. This means, according to our figures, the irrigation efficiency figures would be higher than shown in the Study, less return flows, etc. What effect would this have on salt load calculations (reference back to Comment 4, above)

Response: Our review of the studies to which you refer showed a difference of total consumptive use of alfalfa of 15 percent for the year which was studied when compared to our study. We felt that this comparison was good and supported our use of the Blaney-Criddle method. The measured data, which was done by the University, was in fact only partially measured, as about 35 percent of the total inches of water used was estimated between measurements and might also be subject to question. Other factors which greatly affected the total average value being different than the field tests are the annual temperature and precipitation variations and the changing cropping pattern. The percentage of alfalfa has significantly declined and the grasses which have replaced that crop use less water.

If there is a small error in the crop irrigation requirements, it is not believed it would significantly effect the results of this Study.

Comment: (6) Have there been any studies made which locate the areas where most of the salt is coming from? It seems the report assumes equal amounts of salt from all the irriagated acres. Is there more salt coming from the high water table area within the irrigation district? How much salt is moving into the irrigated area by natural causes?

Response: No specific studies have been made to locate areas of greater or lesser salt contribution. For purposes of this evaluation the average for all acres was used. This was necessary because specific determinations of what lands may be retired or what lands may have irrigation improvements have not been made. This refinement would be possible during the implementation phase of the project. In general, the greatest salt contribution comes from the area which is fartherest from the natural drainages.

The natural salt contribution is shown on page 1-7.

Comment: (7) How much salt will the wildlife habitat areas contribute if installed wetland alternative(s) are selected?

Response: In maintaining the wetlands, it was assumed that those remaining would be lined to reduce seepage. Therefore, they will contribute less than they do under present conditions.

Comment (8): Page S-3. The landowner alternative selected to retire 87 percent of the irrigation on the project should mention right at this point that this was assuming a $2,000 per acre buy-out. People will read this part of the report and never get to the full details later in the report.

Response: The full details are in other parts of the report.

Comment (9): How can any kind of alternative selections be made before the WPRS has made its studies? Decisons are being made on very limited information which can have a deep impact on the landowners in the area and community.

Response: The WPRS studies are complementary to this study. Any on-farm salinity control measures implemented would reduce the quantity and improve the quality of the water that must be accommodated downstream by the WPRS.

Comment (10): Has proper attention been given to gravity pressure sprinkler systems? There is enough head from the reservoir to the project lands for such a system. Estimates are that electrical rates will be 13¢ per kilowatt hour by 1990. The cost-benefit ratio may not show feasibility at today's costs, but may in a few years (use $2,000 buy-out money for this alternative rather than taking people off the land).

Also, we have studies underway that show acceptable uniformity coefficients of water application with certain sprinkler nozzles at pressures as low as 15 psi. Field studies will continue this summer on new low-pressure sprinkler nozzles using sideroll sprinklers.

Response: The available head is completely inadequate to operate a sprinkler system without additional energy. Even 15 psi would not be available except very near the reservoir, provided the reservoir was full. See page 3-3 for details of gravity pressure for a sprinkler system.

Comment (11): It seems to me that there should be no decisions made or even implied until detailed data has been gathered and properly analyzed. Peoples' lives and futures are dependent upon data that leaves no question to what is now taking place. There is no room for guesswork. Do we really have all the facts?

Response: Detailed data have been gathered and analyzed. The conclusions and facts have been presented in this report for subsequent use by the concerned decisionmakers.

environmental benefits than those proposed by SCS. In any event, a final decision on the Big Sandy should be deferred until the studies to be conducted by the Water and Power Resources Service are completed and other approaches by the State have been explored.

The proposed "federal buy-out" of irrigated land and retirement of land from production could jeopardize other programs which seek to bring land into irrigated production. Therefore, this alternative should not be considered as a viable alternative at this time. Further, I am concerned that this approach has raised the expectations of the landowners in the area for a quick and easy solution to reducing the salinity in the Eden-Farson area.

Response: If the irrigation return flows are marketed to industry, there is no doubt that economic benefits will be realized. There is some concern that the use of saline water by industry will result in very high treatment costs, which may ultimately cost many times more than the aricultural alternatives shown in this report. This is pointed out by the cost industry is now undergoing to treat the moderately low-salinity water of the Green River. It should be noted that industry will pass along to the general public the cost of treating the water. We feel that the alternatives evaluated in this report would reduce the amount of low-quality water and salt the State and Water and Power Resources Service would need to evaluate during their studies.

There is also the question of how the water can be marketable as long as high quality water is available. The concern is that the studies and search for a market will continue for many years, while the farmers continue to suffer economic hardships and the salinity problem continues unabated.

Comment: Additionally, I am formally requesting that the SCS not take any further action on this alternative until the State and the Water and Power Resources Service have had an opportunity to explore other remedies to the salinity problem in the Big Sandy and Green River drainages in Wyoming.

Response: It is SCS responsibility to submit this report in a timely manner. SCS has satisfied this responsibility. We acknowledge that further investigations are underway by other agencies and organizations that concern alternatives that are beyond the responsibility of USDA.

ARIZONA WATER COMMISSION

Comment: The report shows that irrigation in the study area results in the contribution of an estimated 133,300 tons of salt per annum to the river system. Impacts of the Landowner Preferred-Modified Alternative (Alternative 12) would

result in a reduction of the salt loading by about 113,000 tons per year, which represents a reduction of 14.3 mg/l at Imperial Dam. The estimated costs of Alternative 12 is about $35.9 million; the annual benefits are about $6.7 million; and the annual equivalent cost per ton of salt reduction is about $24.50. Provided these estimates are reliable, Alternative 12 is one of the most favorable salinity reduction proposals to date. It would be less than one-half the cost per mg/l reduction of salinity at Imperial Dam of the stage one development for the Grand Valley Unit.

Response: This favorable comparison is noted.

Comment: One final comment. The $5.5 million for structural improvements and $97,000 per annum for OM&R appears overly burdensome for improving irrigation practices on 2,000 acres of land. The OM&R cost of almost $50 an acre each year may equal or exceed the crop value at these high elevations. Perhaps a means to keep the 2,000 acres irrigated could be found that would pose less capital and OM&R costs.

Response: Detailed studies for means to convey water to remaining irrigated lands will need to be made after implementation is approved.

WATER AND POWER RESOURCES SERVICE

Comments: Some references to the Bureau of Reclamation in the report should be changed to the Water and Power Resources Service; for example, pages S-1, S-2, and I-3.

Specific Comments:

Page S-2, Line 17 - Change underground rock aquifer to ground aquifers. There is more than one aquifer.
Line 19 - Change "provide the water" to "provide the mechanism."

Page I-5, Introduction, Line 18 - Change to read to the salinity problem.

Page 1-1, Lines 12-13 - Only two wells are known to be in the saline aquifer. The remainder are in the deep, fresh water aquifer.

Page 1-3, Figure 1-1 - You might want to segregate the drains. Surface water inflow to drains is 13,000 acre-feet. Drain discharge returning to river is 2,775 acre-feet.

Page 1-8, Line 8 - Should the 37,700 tons be 32,700 tons?
Line 9 - The saline aquifer is artesian below the irrigated area. Unless all of the artesian head were eliminated the expected reverse flow could not occur.

Page 2-7, Line 15 - The word alternatives is misspelled.

Page 3-4, Line 14 - The excavated potholes would probably increase seepage which could increase salinity.

Page 3-6, Line 6 - Change "a" to "an."

Page 3-22, Line 10 - The storage capacity of 13,440 acre-feet appears to low. Is this the annual pumpage?

Page 3-24, Figure 3-1 - Refuge is misspelled.

Page 3-26, Line 19 - Should say the project efficiency decreased from 32 percent to 20 percent.

Page 4-6, Line 3 - Big Sandy water at 6,000 ppm is not highly saline.

Page A-6, Lines 9, 12, and 14 - Replace the word "in" with "by" to show that construction was completed by these dates.

Page A-8, Line 11 - Revise to say that a test well was drilled, rather than an observation well.

Page A-15, Line 18 - Suggest gravel be deleted. There is very little gravel on the Eden Project.

Response: The changes and corrections were made.

FOREST SERVICE

Comment: The only comment we have is that all references to the Bureau of Reclamation should be changed to agree with their new title - Water and Power Resources Service.

Response: This correction has been made.

MARVIN N. APPLEQUIST I
MARVIN N. APPLEQUIST II
PETER APPLEQUIST

Comment: We believe the only method that could be used in this Valley that would control the salt in the river, would be by using a sprinkler system. If someone gave us the sprinklers and replaced them as they wore out we still could not afford to use them. Our crops are too small and limited and the growing season is too short for us to pay for the operating costs of the sprinklers.

When we considered the vast amount of money that it would take to install, maintain, and operate a sprinkler system, along with the small returns from our crops, we feel the best way to stop the salt problem in this Valley is to quit irrigating.

We sincerely request that something be done with this report as soon as possible. It is very difficult to make plans and operate our farm with this study and all the publicity about the salt hanging over our heads. This situation is impossible to live with and is hurting us seriously financially.

Response: The SCS is responsible for completing and submitting this report at this time. What action may be taken and when is not known.

JUSTYNE TOMICH

Comment: We note on each of the alternatives a notable salinity reduction at Green River that results in a very minor reduction at Imperial Dam (see chart enclosed). This makes it appear that great sums of money can be spent to reduce salinity in the Big Sandy River. However, the salinity seems to increase as the waters travel downstream and arrive at Imperial Dam. Our logic would conclude, perhaps a large desalinization plant just above Imperial Dam is the real answer to the problem.

Response: The impact on salinity reduction in the Green River is much greater than in the lower Colorado River because of the proportionately larger amount of salt we are dealing with; i.e. the Big Sandy contributes a large proportion of the salt in the Green River at Green River, Wyoming, but only a small portion of the total in the Lower Colorado River. The question of whether desalinization is more cost effective can best be answered by those who have studied those costs. (Refer to the letter from the Arizona Water Commission).

Comment: Basically, we are stating again that our lives have been built in this area, hopefully improving our farm, and we wish to continue this life style. Perhaps someday our son will want to continue operating the family farm unit. Therefore, we again request consideration for the existing agricultural community in remembering that inflation alone is difficult enough to cope with; so please exert all caution to help us continue without adding additional expenses to our operations that will force us out-of-business.

Response: By presenting various alternatives SCS believes it has provided for the expression of local citizen interests through the Coordinating Committee.

JAMES HODDER

Comment: Either irrigation retirement or sprinklers are the only alternatives that I feel would have very much effect on salinity reduction. Automatic borders on our porous

soil probably wouldn't be feasible to farm as the length of runs would have to be less than 500 feet and with topsoil a minimum anyway the leveling needed wouldn't leave any topsoil in many places.

With energy costs the way they are now, it would take a healthy cost-sharing program on Operations and Maintenance for the farmers to be able to justify them.

If land retirement is the option taken, I feel a provision should be made to consider the sale an involuntary conversion and the people be given 2 to 3 years to relocate.

The time for a decision is now. It is almost impossible to get enthused about improving your place if you don't know if anyone will farm it in the future. I feel this study has devalued our land. It has made it hard for people that need to sell, for various reasons, to do so.

I know there is no easy solution to the problem, but it is time to do something or decide to live with the problem as it is.

Response: We agree that decisive action is desirable as soon as practicable.

AARON NEALE JONES
WILLIAM LEE HARNS

Comment: After reviewing all statements, comments, and research at all public meetings and the above mentioned publication, it is readily apparent that the only feasible solution is one of the three alternatives that retire irrigation practices. Namely 6, 8, or 12.

These are the only sensible alternatives as the cost-benefit ratio is very favorable. They achieve maximum salt loading reduction while giving a relatively small number of people the opportunity to relocate their operations. This is preferable to all other alternatives as the remaining alternatives will increase landowner debt, reduce available water, be energy inefficient, very costly and not achieve significant salt reduction. We also feel that these three alternatives are very definite and final. There would not be any need to look at it again in five or ten years.

This study and the publicity it has received has put the agricultural community in the Eden Valley Irrigation District in a very untenable position. At the present time our land is valueless with this proposal over us. We are unable to expand or make major improvements as money is not available to some of us due to this study. It is imperative that this matter be resolved in the very near future. No community needs the problems this study has brought on us.

Response: It was not expected that this study would be perceived to have such a negative impact on the community. SCS agrees that the matter of irrigation retirement should be resolved as soon as practicable.

Comment: Concerning the proposed figures mentioned in the study for land or water purchases, we question how much research has gone into these figures and we feel they should be reviewed with the landowners.

Response: The organization selected for implementation should do the additional research and review.

COLORADO RIVER BOARD OF CALIFORNIA

Comment: (1) The report presents a number of alternaties for salinity control, most are very cost-effective. We support all cost-effective solutions to the salinity problems in the Colorado River Basin. One alternative, Landowner Preferred-Modified has the support of the local citizens, an extremely important element in the successful implementation of salinity control activities. However, this alternative leaves some 2,000 acres in production for which irrigation systems improvements are proposed. Continued efforts should be made to reduce the costs of salinity control on that acreage, as the estimated cost per acre for salinity control is $3,425 per acre as compared to $2,000 per acre for land treatment.

Response: Allowing continued irrigation where the landowner so desired was assumed necessary to obtain local support of the project. It is possible to continue that irrigation with the existing system. However, the cost of $3,425 per acre is more than justified by the incremental increase in benefits (compare with Alternative 11).

Comment: (2) Page I-2, Figure 1-1. The irrigated areas should be shown on this figure.

Response: We agree, the irrigated acres have been added.

Comment: (3) Page I-6, Lines 1 and 2. Identify the location of the "Big Bend" area.

Response: The area is now more clearly described (see page I-4).

Comment: (4) Page I-7, Lines 7 thru 9. This paragraph implies that ASCS cost-share funds are available once the project is approved. This is not the case. To the best of my understanding, USDA has not included funds for on-farm salinity control activities in its current budget and it has only

been through the efforts of the Colorado River Basin states in Congress that funds have been earmarked for on-farm cost-share salinity control activities in the Colorado River Basin. This misconception regarding the availability of funding should be clarified.

Response: The paragraph has been expanded to clarify this point (see page I-4).

Comment: (5) Page 1-8, Lines 4 thru 9. It is unclear how the mechanism described for increased salt loading takes place. Is the value 32,700 tons or 37,700 tons?

Response: The sentence has been changed for clarity. The correct value is 32,700 tons.

Comment: (6) Page 2-1, Lines 7 thru 8. Recognition of water quality problems as early as 1903 seems somewhat early.

Response: This date was used in an article entitled "Salinity Countdown on the Colorado" by Gilbert G. Stramm, Commissioner, U.S. Bureau of Reclamation published in the July 1975 issue of WATER INTERNATIONAL.

Comment: (7) Chapter 3, Alternatives and Their Impacts. 1) Maps showing the lands affected by each alternative would be beneficial in gaining a fuller understanding of each alternative. 2) The significant figures used in the report, to the nearest ten dollars and the nearest salinity reduction in hundredths of a milligram per liter are too precise for the level of data available.

Response: 1) The proposed alternatives affect the entire 15,700 irrigated acres. Alternatives showing different acreages for different practices were not placed on a map because the exact farm locations are not known at this time. Prior to implementation farmers would be contacted for determination of the irrigation practices they desire; then a map will be prepared for project use.

2) We agree, but it is not practical to change the figures in the report at this time.

Comment: (8) Page 4-1, 2, Funding and Cost-Sharing Policy. Full payment of all cost of salinity control, installation, operation, maintenance, and replacement, by the federal government is inconsistent with the contract signed by the Grand Valley Water Users Association and the Department of Interior for operations and maintenance of the irrigation system improvements in Grand Valley, Colorado.

Response: The funding and cost-sharing policies cited in this report are subject to change by the Congress and USDA and should not be compared to the actual contract for the WPRS's work on the Grand Valley Stage 1 area.

Comment (9): Page 4-10, Lines 6 thru 11. The assumption that the 21,600 acre-feet of increased flow in the Colorado River will go to Mexico and serve as dilution water in the determination of salinity reduction, is not a proper assumption.

Response: The assumption is not that the water goes to Mexico, but to Arizona and California. The method used was prescribed to us by the Salinity Control Advisory Council and is being used for all salinity control studies to assure a uniform basis of comparison. The procedure for determining salinity reduction was explained in this section (page 5-9) in the response to comments by the Wyoming Water Development Commission.

Comment (10): Page 4-10, Line 24. The basis for the determination of $12,495 benefit per milligram per liter reduction at Green River, Wyoming, should be presented.

Response: A sample calculation with description of the benefits is explained in this section (page 5-10) in the response to the comments by the Wyoming Water Development Commission.

BUREAU OF LAND MANAGEMENT

Comment: We have reviewed the Big Sandy River salinity study report and feel the only comments that we can provide at this time are (1) until an alternative(s) is selected for implementation it is difficult to determine our involvement and/or impacts to the public domain, and (2) the study report only addresses farm practices, alternatives, and associated impacts. We feel that the impact assessment should relate to the total system; i.e., downstream effects.

Response: (1) We agree.

(2) The effects on streamflow and salinity downstream are presented in considerable detail. Other effects are addressed by the May 1977 final program EIS.

WYOMING GAME AND FISH DEPARTMENT

Comment: Page A-27, line 25 states that the reservoir maintains "populations of rainbow and brown trout." This should be changed to reflect that brown trout is the dominant species, cutthroat trout are present in much lower numbers, and rainbow trout are only incidental in occurrence.

Response: The correction has been made.

ADVISORY COUNCIL ON HISTORIC PRESERVATION

Comment: Therefore, we believe that it would be appropriate for your report to identify the requirement to comply with Section 106 of the National Historic Preservation Act of 1966 (16 U.S.C. Sec. 470f, as amended, 90 Stat. 1320) and the Council's regulations, "Protection of Historic and Cultural Properties" (36 CFR Part 800) so when Federal approval of the project is considered, either in full or in part, the implementing agency will be aware of its responsibilities under Section 106.

Response: Changes have been made in the summary on page S-3 and on page 4-7 to clarify and emphasize the responsibilities under Section 106.

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GLOSSARY

Terms in this report are used as defined in "Resource Conservation Glossary" by the Soil Conservation Society of America, 1970, and in the "Wildland Planning Glossary", General Technical Report PSW-13/1976, Pacific Southwest Forest and Range Experiment Station, USDA Forest Service, 1976; and from definitions especially prepared for this study and report.

Benefits - An assessment of the value of the expected outputs or the desirable effects of a plan or action.

Biome - A major biotic community composed of all the plants and animals and smaller biotic communities.

Cropping pattern - Amount and type of each crop within a designated area.

Deficit - Quantity of water not available to satisfy the consumptive use requirements of the crops at the irrigation efficiency specified.

Environmental Quality Account - One of the required accounts for categorizing, displaying, or accounting the beneficial and adverse effects of each alternative plan for water and related land resources planning specified in the Water Resources Council's "Principles and Standards" and the USDA's "Procedures" for adhering to them.

Environmental Quality (EQ) - Enhancing environmental quality by the management, conservation, preservation, creation, restoration, or improvement of the quality of certain national and cultural resources and ecological systems is one of the two main objectives for programs involving water and related land resources administered by Federal agencies whose activities involve planning and development of water resources, as contained in the Water Resources Council "Principles and Standards".

Excess water - Water diverted to the farm in excess of that needed to fill the soil profile and supply consumptive use and leaching requirements at the irrigation efficiency specified.

External diseconomies - Negative indirect effects.

External economies - Positive indirect effects.

Externalities - Indirect effects occuring throughout the internal operations of the economy due to the introduction of a project that produces direct effects. Direct effects are those that accrue directly to the project measures. Externalities can have a positive or negative effect.

Farm head ditches - A constructed open channel for transportation of water from a canal or lateral to a point of distribution into the field.

Feral - Wild or untamed state.

Irrigation efficiency - Ratio of water consumed by crops on an irrigated area to the amount of water delivered at the farm headgate.

Microzones - Small area of possible archeological significance.

National Economic Development Account - One of the required accounts for categorizing, displaying or accounting the beneficial and adverse effects of each alternative plan formulation for water and related land resources planning specified in the Water Resources Council's "Principles and Standards", and the USDA's "Procedures" for adhering to them.

Net irrigation requirements - Quantity of water needed to meet consumptive use needs of the crop after accounting for effective precipitation and use from the water table.

Net return - The residual value of production after costs of production are subtracted from the gross returns.

Part Per Million (PPM) - One part by weight of dissolved chemical, or suspended sediment, in one million parts by weights of water.

Permeability - The quality of a soil horizon that enables water to move through it.

Petroglyphs - Drawing or carvings on a rock.

Principles and Standards - Guidelines for water and related land resources planning established by the U.S. Water Resources Council for Federal agencies whose activities involve planning and development of water resources. The Principles provide the broad framework for planning activities and include the conceptual basis for planning. The Standards provide for uniformity and consistency in comparing, measuring, and judging beneficial and adverse effects of alternative plans.

Regional Development Account - One of the required accounts for categorizing, displaying, or accounting the monetary beneficial and adverse effects on Green River Basin in the State of Wyoming and Lower Colorado River Basin of each alternative plan for water and related land resources planning specified in the U.S. Water Resources Council's "Principles and Standards" and the USDA's "Procedures" for adhering to them.

Salt loading - The pickup of salt from a natural material by water.

Social Well-Being Account - One of the required accounts for categorizing, displaying, or accounting the beneficial and adverse effects of each alternative plan for water and related land resources planning specified in the Water Resources Council's "Principles and Standards" and the USDA's "Procedures" for adhering to them.

Structural improvements - Engineering works, exclusive of land treatment and management measures, designed to improve irrigation water application and efficiency.

Terrestrial habitat - Wildlife habitat pertaining to land as distinct from water or water influenced land.

Total disolved solids - The total dissolved mineral constituents of water.

Wetland category and type -

Wetland category and type	Water depth
INLAND FRESH AREAS:	
1. Seasonally flooded basins or flats	Few inches in upland; few feet along rive
2. Inland fresh meadows	Few inches after heavy rains
3. Inland shallow fresh marshes	Up to 6 inches
4. Inland deep fresh marshes	Up to 3 feet
5. Inland open fresh water	Up to 10 feet; marshy border may be prese
6. Shrub swamps	Up to 6 inches
7. Wooded swamps	Up to 1 foot
8. Bogs	Shallow ponds may be present
INLAND SALINE AREAS:	
9. Inland saline flats	Few inches after heavy rain
10. Inland saline marches	Up to 20 feet
11. Inland open saline water	Up to 10 feet; marshy border

Reference: "Wetlands of the United States," Circular 39; Fish and Wildlife Service, Department of the Interior.

Wetland mitigation - "Mitigation" includes:

(a) Avoiding the impact altogether by not taking a certain action or parts of an action.

(b) Minimizing impacts by limiting the degree or magnitude of the action and/or implementation.

(c) Rectifying the impact by repairing, rehabilitating, or restoring the effected environment.

(d) Reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action.

(e) Compensating for the impact by replacing or providing substitute resources or environments.

Work-Year - The amount of labor that can be supplied by an able-bodied person in one year.

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APPENDIX A

Description of the Study Area

Location and Land Use

The Big Sandy River Unit is located in southwestern Wyoming, approximately 30 miles north of the Town of Green River. The Study Area encompasses parts of Sublette, Fremont, and Sweetwater Counties. The watershed as outlined in Figure I-1 (Page I-2) is made up of two major drainages, the Big Sandy River and Little Sandy Creek. The Big Sandy River is a left-bank tributary of the Green River.

The total Unit area is 1,918 square miles (1,227,520 acres), with 758 square miles in Sublette County, 91 square miles in Fremont County, and 1,069 square miles in Sweetwater County. Included in the Big Sandy Unit is a non-contributing area named Sublettes Flat, lying directly north of the lower reach of the Big Sandy River.

The Big Sandy River and its major tributary, Little Sandy Creek, originate at elevations of about 13,000 feet mean sea level (msl) in the Wind River Range of the Bridger National Forest. These streams flow in a southwesterly direction, coming together within the irrigated area of Eden Valley, near the community of Farson. From this juncture, the Big Sandy River continues southwesterly for another 26 miles before entering the Green River.

The Bureau of Reclamation, now the Water and Power Resources Service (WRPS), Withdrawal Area comprises approximately 90,000 acres. The area is approximately 21 miles long in a north-south direction and about 7 miles wide (east-west direction). The upper north end of the withdrawal area encompasses the Big Sandy and Eden Reservoirs.

There are about 18,000 acres of irrigated farmland in the study Unit area of which about 2,500 acres are idle any given year. The Eden Valley Project comprises 17,087 acres of the total irrigated land. Detailed investigation indicates approximately 15,700 acres are presently being irrigated. The principal crops grown in order of acreage are alfalfa, other hay, pasture, and small grains.

Some 68 percent of the watershed is National Resource lands administered by the Bureau of Land Management. About 15 percent is National Forest land administered by the Forest Service, and about 9 percent is WPRS withdrawals for agricultural purposes. The remainder of eight percent is equally divided between private and State ownership, (see Table A-1). The significance of ownership is readily apparent when considering the need for a cooperative watershed management program.

Table A-1 Land Ownership, Big Sandy River Watershed, Wyoming

Administration or Ownership	Acres	Percent
Bureau of Land Management	831,760	68
Forest Service	182,160	15
Water and Power Resources Service	108,880	9
Private	54,500	4
State	50,220	4

The major land use is range or pasture lands which constitute 1,096,970 acres, or 89.0 percent of the total watershed area. The forested land of the mountains total 74,600 acres, of which 62 percent is suitable for grazing by domestic livestock. The irrigated cropland accounts for approximately 18,000 acres, or only about 1.6 percent of the area. No dry cropland is currently being farmed in this area. Other land uses total 37,950 acres.

History

The route adopted by the first immigrant trains of 1842 in their journey to Oregon and California traversed an opening in the Wind River Mountains now known as South Pass. Emerging from this pass, the pioneer caravans traveled in a southwesterly direction for 25 miles through the Big Sandy drainage and the area now comprising Eden Valley.

Permits for irrigation were first issued to settlers to divert water from the Big Sandy River for lands within the Eden Project area in 1886. The Farson, Son and Company was the original sponsor of the Eden Irrigation and Land Company. The Company organized the first official project in 1905, which was to consist of the Eden Reservoir and canals and a large reservoir at Leckie Ranch to store water transported from the headwaters of Big Sandy Creek and East Fork of New Fork River. However, the Leckie Ranch Reservoir was never started. Construction bonds were issued and construction commenced in the summer of 1907 and was completed in 1914 on the canals and Eden Reservoir. Settlement of land under this development began in 1910.

Through default in meeting bond obligations the Eden Irrigation and Land Company went into receivership and was purchased by the Rock Springs Water Company in 1927. The company carried on with the management of the project for a few years and then went into receivership. At that time, 13,822 acres were covered with water rights and irrigation water was supplied to 9,000 acres. In 1932 the Wyoming Land and Water Company, a Wyoming corporation, purchased the project.

Works originally constructed had sufficient capacity to serve lands as intended, although many structures were evidently poorly designed and constructed. Various companies which have owned the project since it was first started were handicapped by insufficient funds for O&M and found it impossible to make necessary repairs, resulting in continuous deterioration.

Poor surface and subsurface drainage became evident on portions of the irrigated lands. The use of irrigation water apparently had been excessive with more water applied to the land than necessary for crop growth and there was evidence of high water losses by seepage from canals and laterals. A high water table developed over the underlying sandstone and shale formations that restrict ground water percolation.

Because of the weakened condition of the Eden irrigation system and serious drainage problems, the WPRS investigated possibilities of rehabilitating and extending the project. The WPRS formulated a plan of development that involved construction of a dam at the Big Sandy site on Big Sandy Creek, in lieu of the Eden reservoir, to impound 35,000 acre-feet of active storage for the purpose of serving 20,000 acres of previously irrigated and new lands. In addition to construction of the Big Sandy Dam, the plan provided for enlargement of the Eden Canal, rehabilitation and extension of the existing lateral system, and construction of drains. The plan was approved for construction by the President on September 18, 1940, under the provisions of the Water Conservation and Utilization Act of August 11, 1939. The WPRS was designated as the construction agency and the Department of Agriculture was made responsible for land development, operation and maintenance, and collection of reimbursable costs. Construction of the Big Sandy Dam and Reservoir was started in 1941, with Civilian Conservation Corps labor. Work was about 16 percent completed when stopped by order of the War Production Board in December 1942.

Because of the great increase in construction costs as an outgrowth of World War II and loss of finiancial support by such agencies as the Work Projects Administration (WPA) and the Civilian Conservation Corps (CCC), the WPRS determined that reauthorization of the project by Congress would be necessary before construction could be resumed. In January 1949, the WPRS made a report in which it recommended that the plan of development for the project be revised. Completion of the project was authorized by the Act of June 38, 1949, Public Law 132, 81st Congress, 1st Session (63 Stat. 277). This authorizing act provided for such modification in the physical features of the project as the Secretary of the Interior may find will result in greater engineering and economic feasibility.

A contract between the United States Department of the Interior and the Eden Valley Irrigation and Drainage District encompassing repayment, operation and maintenance, and other matters was signed June 8, 1950.

Construction was resumed in 1950 with minor modifications in the project plan as reauthorized in 1949. Construction of all irrigation facilities except deferred drainage was completed by 1960. Big Sandy Dam was completed in 1952 and storage of water started in 1953. The Means Canal was used for the first time in 1953. Canals and laterals and the initial drainage system were completed by 1959 (see Figure A-1). Rehabilitation of the Little Sandy Diversion Dam Canal and the Eden Reservoir outlet works were completed by 1960.

The 1949 authorization for the Project provided for irrigation of about 20,000 acres of land. Only about 17,500 acres, however, have been developed and prepared for irrigation of which approximately 15,700 acres are being irrigated at the present time. The developed lands include about 9,850 acres that were settled under the original Carey Act program through private enterprise and about 7,700 acres that were developed under the 1949 authorization. Land development was not extended beyond 17,500 acres after it became evident that the available water supply would not be adequate for the 20,000 acres authorized. With cost-sharing assistance through U. S. Department of Agriculture Programs, further improvements are being made by farmers. Such improvements include land leveling, enlargement of farm turnouts, and reorganization on-farm distribution systems to increase irrigation efficiency.

Beginning in the spring of 1960, the WPRS undertook a general review of the Eden Project water supply shortage. In 1961, 6.6 miles of the West Side Lateral were treated with soil sealant and in 1962 it was applied to other laterals. Also, in 1962, soil sealant was applied to 3.4 miles of the McComas Lateral. Subsequent measurements of seepage losses indicated that the sealant lost its effectiveness rapidly and was not a satisfactory treatment.

In August of 1962, a test well was drilled to test availability of ground water as a possible source of additional irrigation water. Results of that well and observations of other wells in the area revealed that development of a project water supply from ground water sources would not be economically feasible.

Diverting water from the East Fork of New Fork River to supplement the flows of Big Sandy River and Little Sandy Creek was also investigated. Additional water from the East Fork of New Fork River will require additional storage regulation in a new Sander Ranch Reservoir on Big Sandy Creek. Because of objections from the people in the New Fork drainage area, future work on diversions from East Fork will depend upon streamflow measurements being obtained by the U. S. Geological Survey. Also, a decision by the State of Wyoming approving the diverting of water into the Big Sandy drainage area is necessary.

In January 1966, a contract was awarded for earth lining of the Means Canal and West Side Lateral and sublaterals. This work was completed in 1967. The estimated annual water savings resulting from this lining amounts to about 4,700 acre-feet annually.

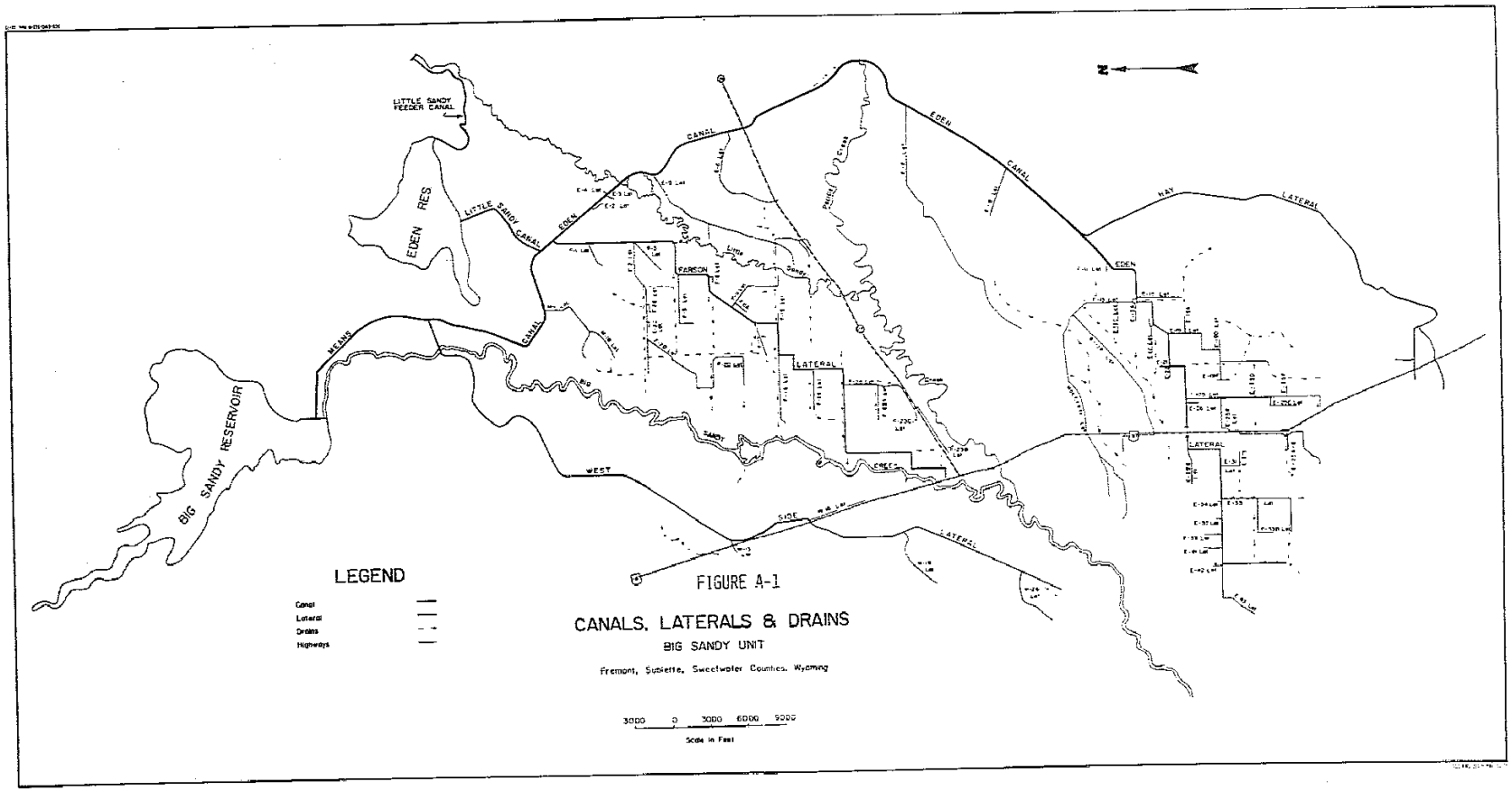


FIGURE A-1

CANALS, LATERALS & DRAINS

BIG SANDY UNIT

Fremont, Sublette, Sweetwater Counties, Wyoming

By contract of June 8, 1950, with the United States, the Eden Valley Irrigation and Drainage District assumed responsibility for repayment of project costs and agreed to assume responsibility for project operation when notified by the Secretary of the Interior. The project was turned over to the district in 1970 and they are operating the water collection and supply system at this time with technical assistance from the WPRS.

Socioeconomic

According to data gathered for the USDA Cooperative Green River Basin Study, dated September, 1978, there are an estimated 28,200 acres of irrigated land in Sweetwater County. Some 15,700 acres are within the Eden Valley Irrigation Project.

During the 12-year period 1962-73, the Eden Valley Irrigation Project served an average of 84 farms with a total population of 279 people. The average irrigated acreage during this period was 14,566, averaging 173 acres per farm. The gross value of agricultural production per farm was estimated to be $7,508 or $43.40 per acre. This relatively low gross value is one reason for some 79 of the 84 operators currently being part-time farmers.

Off-farm employment is generally considered by many local farmers as their primary source of income, with hay production for livestock only supplemental. The following from the County and City Data Book, 1977, Bureau of the Census, depicts the type of businesses and economic level in Sweetwater County:

Industry Type	Number	Economic Level
Manufacturing	11	Payroll - $1.6M
Wholesale	44	Sales - $22.2M
Retail	270	Sales - $60.8M
Selected Services	197	Payroll - $3.0M
Mineral Industries	69	Shipment Value - $116.7M
Agriculture	106	Products - $9.1M

The total Sweetwater County farm population in 1970 was 414. The estimated 279 residents in the Eden Valley Irrigation Project constitute over 67 percent of the farm population in the county. Over 55 percent of the irrigated land in the county is within the project area.

The population of Sweetwater County has increased from 18,391 (1970) to 21,200 (1972), to 30,144 (1975) to 38,310 (1976). In 1975 Rock Springs population was 17,773 and Green River was 7,423. The 1970 population of the County was 87.1 percent urban and 12.9 percent rural, with a slow rural decreasing trend. Additional industry growth since 1976 has added to this change.

The Wyoming Agricultural Statistics, 1978, published by the Wyoming Crop and Livestock Reporting Service, Cheyenne, shows that out of the 23 counties in Wyoming, Sweetwater County ranks as follows in production.

	All Cattle	Milk Cows	Stock Sheep	All Hogs	Barley	Oats	All Hay
Rank	17	20	7	19	20	18	22

Yield data including acres planted by years in Sweetwater County by crops and number of livestock by class is as follows:

	1974	1975	1976	1977	1978	1979
Cattle & Calves	18,000	19,000	21,000	20,000	18,000	18,200
Stock Sheep	102,000	96,500	84,000	76,000	56,000	55,600
Barley (Ac)	300	200	200	100	150	N.A.
(Bu/Ac)	50	50	75	45	65	N.A.
Oats (Ac)	700	600	800	700	600	N.A.
(Bu/Ac)	33	51	56	51	55	N.A.
All Hay (Ac)	17,500	20,200	19,000	17,000	17,000	N.A.
(Tons/Ac)	1.43	1.54	1.39	1.29	1.19	N.A.
Alfalfa Hay (Ac)	9,000	10,000	9,000	7,000	7,000	N.A.
(Tons/Ac)	1.70	2.00	1.70	1.40	1.40	N.A.
Other Hay (Ac)	8,500	10,200	10,000	10,000	10,000	N.A.
(Tons/Ac)	1.15	1.08	1.11	1.22	1.08	N.A.

The Eden Valley Irrigation Project is entirely within the Big Sandy River Unit Salinity Study. The study is also within the "Sandy Grazing Area" administered by the Bureau of Land Management (BLM). This area is about two million acres in size, covering portions of four counties located in southwestern Wyoming. The four counties and their 197[illegible] populations are: Sweetwater County - 38,310; Uinta [illegible] Lincoln County - 9,868; and Sublette County - 4,080. 27.7 percent (17,245) of the total 62,276 four county [illegible] outside the two largest population urban areas of ea[illegible] include Green River, Rock Springs, Evanston, Lym[illegible] Big Piney, and Pinedale. None of these urban a[illegible] Sandy Grazing Area.

According to the BLM Sandy Grazing Environmental Statement, when considering industries by economic sectors, the contributions of livestock production to the agricultural sector in terms of assessed valuations, would not be expected to increase in the future. In this area, the agricultural industry is a static, or perhaps even declining, sector within a growing economy. The mineral-related industries, with their dynamic anticipated growth, would keep the percentage of assessed valuation to livestock declining.

The basic concern of residents in the Sandy Grazing Area generally center on one theme, maintaining what they consider to be a rich and rewarding way of life. This way of life is dependent upon the land and reflects traditional western attitudes of independence, self-sufficiency, and love of the outdoors. They consider the open spaces of the West essential to their well-being, and they believe the rural atmosphere of the area is worth keeping.

Climate

The climate of the Eden-Farson area is classified as semiarid. The essential feature of a semiarid climate is that the potential evaporation from the soil surface and the vegetation exceeds the average annual precipitation.

Precipitation ranges from 40 inches or more annually on the Wind River Mountain range to 7-8 inches annually for the irrigated area in Eden Valley (see Table A-2). Irrigation is essential in the farmland areas. Peak precipitation months are April, May, and June. The average monthly precipitation at Farson varies from 0.32 to 0.96 inches.

Table A-2 Land Resource Areas for the Big Sandy River Watershed, Wyoming

LRA	Description	Precipitation	Fremont County	Sublette County	Sweetwater County	Total
		--inches--	----------	square miles	----------	
45	Alpine meadows and rockland	20-50		47		47
43	Northern Rocky Mountains	20-40		68		68
46	Northern Rocky Mountain foothills	12-20	91	283		374
34	Central desertic basin, mountains and plateaus	7-12		360	1,069	1,429
	TOTAL		91	758	1,069	1,918

While snowfall may occur as early as September and as late as July, the common period of snowfall is from October to May. Rock Springs, located 40 miles south of Farson, averages 44.6 inches of snow annually, although snowfall in excess of 80 inches has been recorded. The snow cover generally remains on the ground during the winter months, and winter sheep grazing in the area depend a great deal on the availability of snow for stock water. Local snow

depths also affects big game activity and movement patterns. "Killer storms" such as those in 1948-49 and 1971-72, cause high mortality among domestic and big game animals due to the combined severity of snow depth, crusting of snow, low temperatures, and high winds.

The high altitude and relative low humidity cause considerable variance in temperatures. The mean annual temperature is 37°F, with a recorded extreme range of -55°F to 95°F. Freezing temperatures have occurred in every month of the year. There is only a 50-50 chance that the growing season will be as long as 85 days (assuming 28°F threshold temperature).

Table A-3 Normal Precipitation and Mean Temperatures, Farson, Wyoming 1/

Month	Mean Precipitation In Inches	Average Temperature °F
January	0.36	9.3
February	0.31	14.6
March	0.96	23.9
April	1.00	37.8
May	1.16	47.8
June	1.29	55.9
July	0.44	63.4
August	0.77	60.8
September	0.64	51.6
October	0.73	39.8
November	0.44	24.6
December	0.40	13.2
ANNUAL	7.61	36.9

1/ Climatography of The United States No. 81 (Wyoming) Monthly Normals of Temperature and Precipitation (1941-1970), August 1973

Geology

The plateaus and mountains in the Colorado River Basin are the product of a series of uplifted land masses deeply eroded by wind and

water. However, long before the earth movements which created the uplifted land masses, the region was the scene of alternate encroachment and retreat of great inland seas. The sedimentary rock formations underlying large portions of the basin are the result of material accumulated at the bottom of these seas.

These deposits of sedimentary rock are the Tipton and Fontenell Tongues, as well as the Wilkins Peak and Laney Members (Figure A-2). They were deposited by the Green River Lake, which covered the Green River basin in southwestern Wyoming. These deposits form the Green River Formation. The outer edges of Eden Valley, including Big Sandy Reservoir, consist of these deposits and are mainly comprised of deposits of shale, silt stone, and fine grained sandstone.

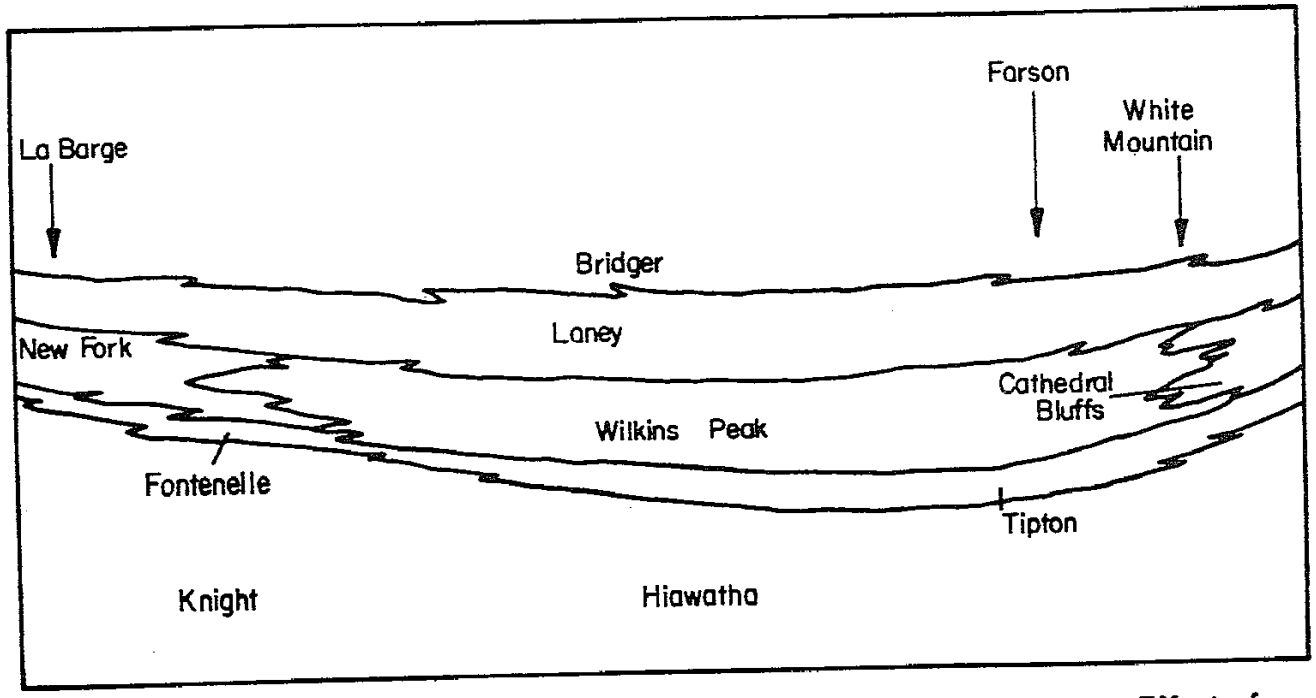
After Green River Lake disappeared, the valley was filled with sediment transported by the streams feeding the valley, Big Sandy River, Little Sandy Creek, and Pacific Creek. These deposits are mostly sand and gravel with some silt and comprise most of Eden Valley proper.

The geology of an area has a profound influence on the occurrence, behavior, and chemical quality of the water resources. In the mountainous origins of most water supplies, a continous interaction of surface water and ground water occurs when precipitation in the form of rain and melting snow enter ground water reservoirs. Eventually, these quantities of ground water return to the surface flows through springs, seeps, and adjacent soil in regions downstream. A further consequence of such a flow system is the addition of water from streams to the ground water storage during low flow periods. The resulting continuous interaction of surface water and ground water allows contact with rocks and soils of the region which cause their chemical characteristics to be imparted to the water.

The interior valleys of the basin, such as Eden Valley, do not receive large enough amounts of precipitation to significantly recharge the ground water storage. Usually, the water bearing aquifers are buried deep below the valley floor and are fed in and along the high precipitation areas of the mountains. The Tipton Tongue is believed to be the principal artesian aquifer underlying Eden Valley. Shallow ground water supplies are predominately the result of excessive irrigation. Although the water in the consolidated rock formations of the valley region does not contribute to streamflow, as is the case in higher elevations, it does have a pronounced effect on water quality. High intensity thunderstorms bring surface runoff in contact with the rocks and soils which then distribute their chemical characteristics. The long erosion by rivers and streams has deposited alluvium along certain valley lengths and thus serves to produce an interchange of water in these areas.

Soils

A detailed soil survey was conducted on the WPRS withdrawal area of the Eden Project during the early 1950's. Soils investigation of the Big Sandy River Watershed was conducted during late 1975 and early 1976 by SCS and BLM. Soil discussion in this report is limited to the Eden Project.



Note — Diagram Only Shows Bed Relationship and Does Not Take Into Account the Effect of Topography on Outcrop Patterns

Figure A-2 Schematic section showing stratigraphic relationships between Wasatch, Green River, and Bridger formations.

A General Soils Map has been developed for the Eden Project. Soil mapping in the project area indicate soils with shallow depth and strong salinity. Sodicity and poor drainage are problems encountered in soil management. The following general descriptions of the six soils groups correspond to the General Soils Map, (see Figure A-3).

1) Seedskadee-Haterton: Shallow, well-drained loamy soils forming in residuum on undulating to rolling uplands.

2) Fraddle: Moderately deep, well-drained loamy soils forming in residumm on undulating uplands.

3) Graypoint-Ryark Variant: Very deep, well-drained gravelly loamy and sandy soils forming in alluvium or nearly level and undulating stream terraces.

4) Leckman: Very deep, well-drained loamy soils forming in alluvium on nearly level to sloping alluvial fans.

5) Torrifluvents-Fluvaquents: Very deep, well to poorly drained strongly saline and strongly alkaline soils forming in alluvium on nearly level flood plains and alluvial fans and gently sloping draws.

6) Cotopaxi-Kandaly: Very deep, somewhat excessively drained sandy soils forming in wind laid materials on sand dunes.

Water Resources

The surface waters begin in the Wind River Mountain range, which is underlain by Precambrian rock. The water is of high quality containing less than 50 milligrams per liter (mg/l) of dissolved solids as it leaves the mountains. After flowing through the intermediate elevation zones of the foothills, the dissolved solids increase to approximately 120 mg/l at Big Sandy Reservoir (WPRS, 1974). The dissolved solids increase substantially to approximately 2,335 mg/l (12 miles below Farson) as irrigation return flow and subsurface flows are added to the river (WPRS 1955 to 1975). Water quality continues to decline to 3,192 mg/l at the confluence with the Green River, as additional subsurface return flows are added to the Big Sandy River (WPRS 1960 to 1974). These water quality figures were obtained primarily from sampling during the summer growing season. The lower watershed area from Big Sandy Reservoir to the Green River is underlain with saline Tertiary lake-bed materials of the Green River and Bridger formations, which contain an unlimited supply of saline materials for salt pickup by ground water.

Surface water flows are regularly measured for both quantity and quality at various locations in the watershed. These locations are shown on the map in Figure A-4. Table A-4 lists historic annual runoff measured in acre-feet at the gaging stations. There is one diversion from the Watershed, which takes water from Little Sandy Creek by way of the Continental Divide Ditch to land along Lander Creek. The water rights appropriation for this diversion is 22.71 cubic feet per seconds (cfs).

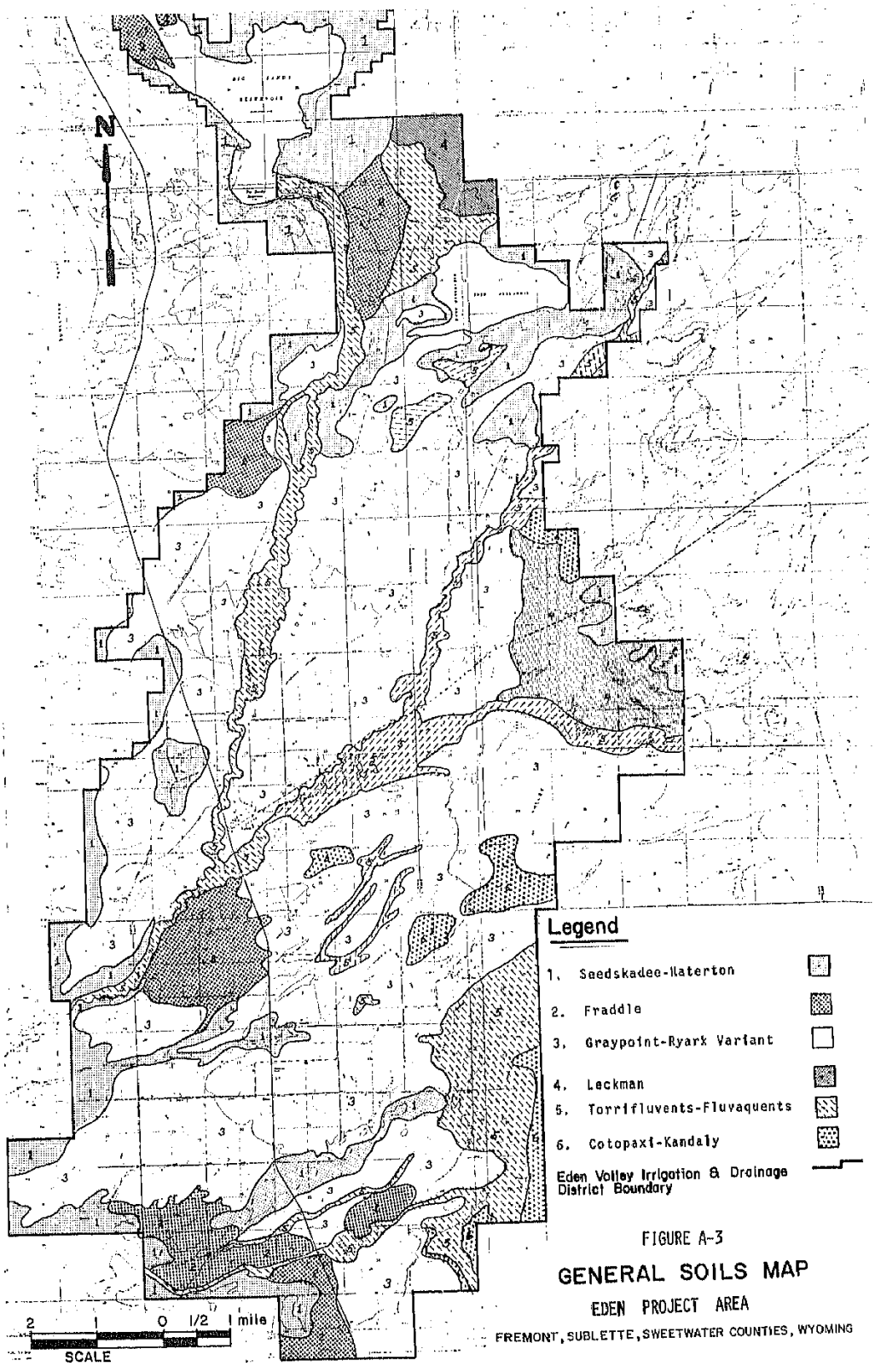


FIGURE A-3

GENERAL SOILS MAP

EDEN PROJECT AREA

FREMONT, SUBLETTE, SWEETWATER COUNTIES, WYOMING

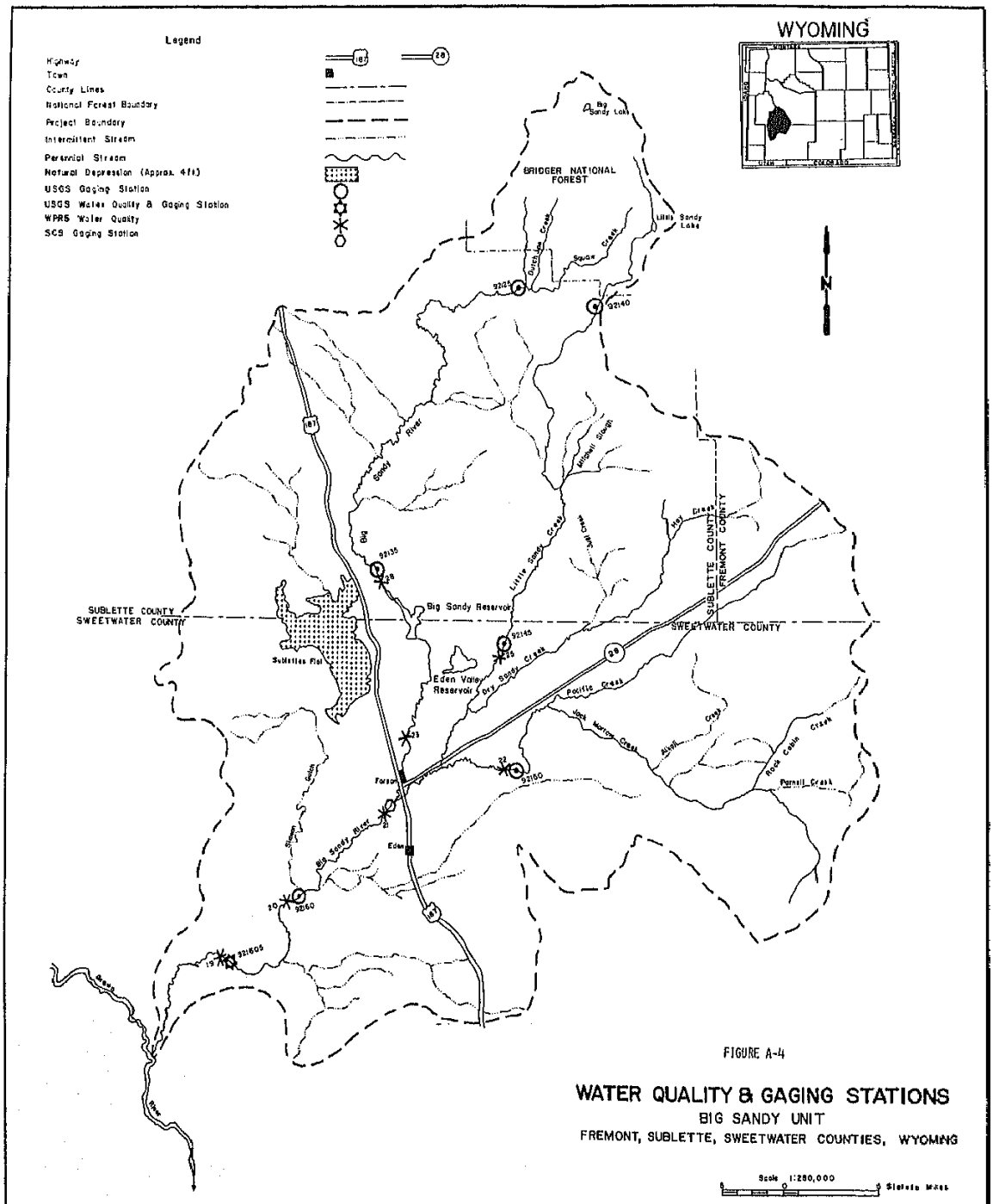


FIGURE A-4

WATER QUALITY & GAGING STATIONS

BIG SANDY UNIT

FREMONT, SUBLETTE, SWEETWATER COUNTIES, WYOMING

Table A-4 Annual stream gage records (1941-1973) [1] and analysis for the Big Sandy River Unit Salinity Study, Wyoming

(1,000 acre-feet discharges)

Year	Big Sandy near Leckie Ranch 09212500	Big Sandy near Farson, Wyoming 09213500	Little Sandy near Elkhorn, Wyoming 09214000	Little Sandy above Eden, Wyoming 09214500	Pacific Creek near Farson, Wyoming 09215000	Big Sandy below Eden Wyoming 09216000
	94 sq. mi.	322 sq. mi.	20.9 sq. mi.	170 sq. mi.	500 sq. mi.	1,610 sq. mi.
1941	60.8	53.0	13.1	10.4	3.0	
1942	56.5	61.3	14.5	12.3	2.6	
1943	76.2	86.1	18.6	17.9	6.1	
1944	57.8	61.8	14.3	10.4	3.3	
1945	61.9	73.3	14.7	9.9	2.6	
1946	60.8	65.9	16.1	11.3	10.4	
1947	79.4	81.7 -3/	20.0	18.6 -4/	2.9 -5/	
1948	55.6	53.1	13.7	11.9	14.2	
1949	50.3	62.8	15.5	11.6	3.6	
1950	90.7	92.0	22.4	20.6	4.1	
1951	76.6	80.0	19.5	20.3	3.6	
1952	73.5	76.6	20.4	13.0	4.6	
1953	40.1	52.4	12.7	11.2	2.4	
1954	54.7	58.3	14.9	13.1	2.9	
1955	46.8	44.5	10.8	7.1	1.9	19.8
1956	65.0	63.0	14.8	11.8	5.6	21.1
1957	78.6	84.9	20.2	16.9	4.6	44.9
1958	47.7	48.9	12.2	9.3	2.1	37.6
1959	39.6	40.8	9.6	6.0	1.6	15.8
1960	30.0	30.9	8.4	5.3	2.9	10.9
1961	34.5	30.3	9.2	5.5	2.6	8.2
1962	70.0	70.4	17.3	14.6	13.6	26.4
1963	62.8	58.3	14.2	12.5	1.4	16.9
1964	57.0	56.6	13.9	10.6	0.9	19.1
1965	100.5	94.0	23.7	20.2	4.8	35.9
1966	46.9	47.2	11.1	9.4	2.8	38.9
1967	91.0	96.0	22.3	20.1	1.5	49.7
1968	76.5	76.5	15.9	15.5	2.4	39.2
1969	80.2	84.3	17.6	15.5	2.6	60.7
1970	51.4	49.6	12.9	8.8	0.6	22.2
1971	74.9	72.5	19.4 2/	18.7	4.2	32.4
1972	90.0	96.4	20.2 2/	20.8	4.9	65.0
1973	65.4	72.4	15.8 2/	18.3	7.1	46.7
1955-73 Period:						
Standard Deviation of flow	19.9	21.2	4.5	5.3	3.0	16.4
19-year mean	63.7	64.1	15.2	13.0	3.6	32.2
Water Yield (in.)	12.70	3.73	13.67	1.43	0.13	0.37
Water Yield (ac.ft./ sq.mi.)	677.3	199.0	729.0	76.4	7.2	20.0
1941-73 Period:						
Standard Deviation of flow	16.8	18.2	4.0	4.7	2.6	
33-year mean	64.3	66.0	15.8	13.3	3.8	
Water Yield (in.)	12.83	3.84	14.18	1.47	0.14	
Water Yield (ac.ft./ sq.mi.)	684.3	204.8	756.3	78.4	7.5	

1/ Taken from Water Resources Data for Wyoming (Surface Water Records), United States Department of the Interior, Geological Survey.

2/ WWPP correlation with USGS Gage 9-2030 East Fork River near Big Sandy, Wyoming.

3/ Taken from WWPP correlation with Gage 9-2030 East Fork River near Big Sandy, Wyoming.

4/ Taken from WWPP correlation with USGS Gage 9-2010 New Fork River near Boulder, Wyoming.

5/ Taken from WWPP correlation with USGS Gage 9-2135 Big Sandy River near Farson, Wyoming.

The reservoir storage rights on Big Sandy River are listed as 21,749 acre-feet for irrigation of 23,946 acres (adjudicated) plus 39,700 acre-feet of storage with an additional 1,158 acres (unadjudicated) for a total of 61,449 acre-feet in the Big Sandy River Basin. Reservoir storages are listed in Table A-5.

Table A-5 Reservoir storages in Big Sandy River Unit Salinity Study, Wyoming

Name	River	Capacity		Surface Area	Year Completed
		Active	Total		
		----Acre-feet-----		--Acres--	
Big Sandy 1/	Big Sandy River	38,300	39,700	2,510	1952
Eden 1/	Offstream	7,100	7,500 3/	900	1910
Pacific No. 2	Pacific Creek	-----	1,400	260	----
Black Joe Lake 2/	Big Sandy	-----	1,100	-----	----
Elkhorn 2/	Little Sandy	-----	1,450	-----	----
TOTAL			51,150		

1/ As given in Water and Power Resources Service's Water and Land Resource Accomplishments Reports.

2/ As given in 1965 report by Iorns, Hembree, and Oakland.

3/ Adjudicated water right for Eden Reservoir is listed as 18,489 acre-feet.

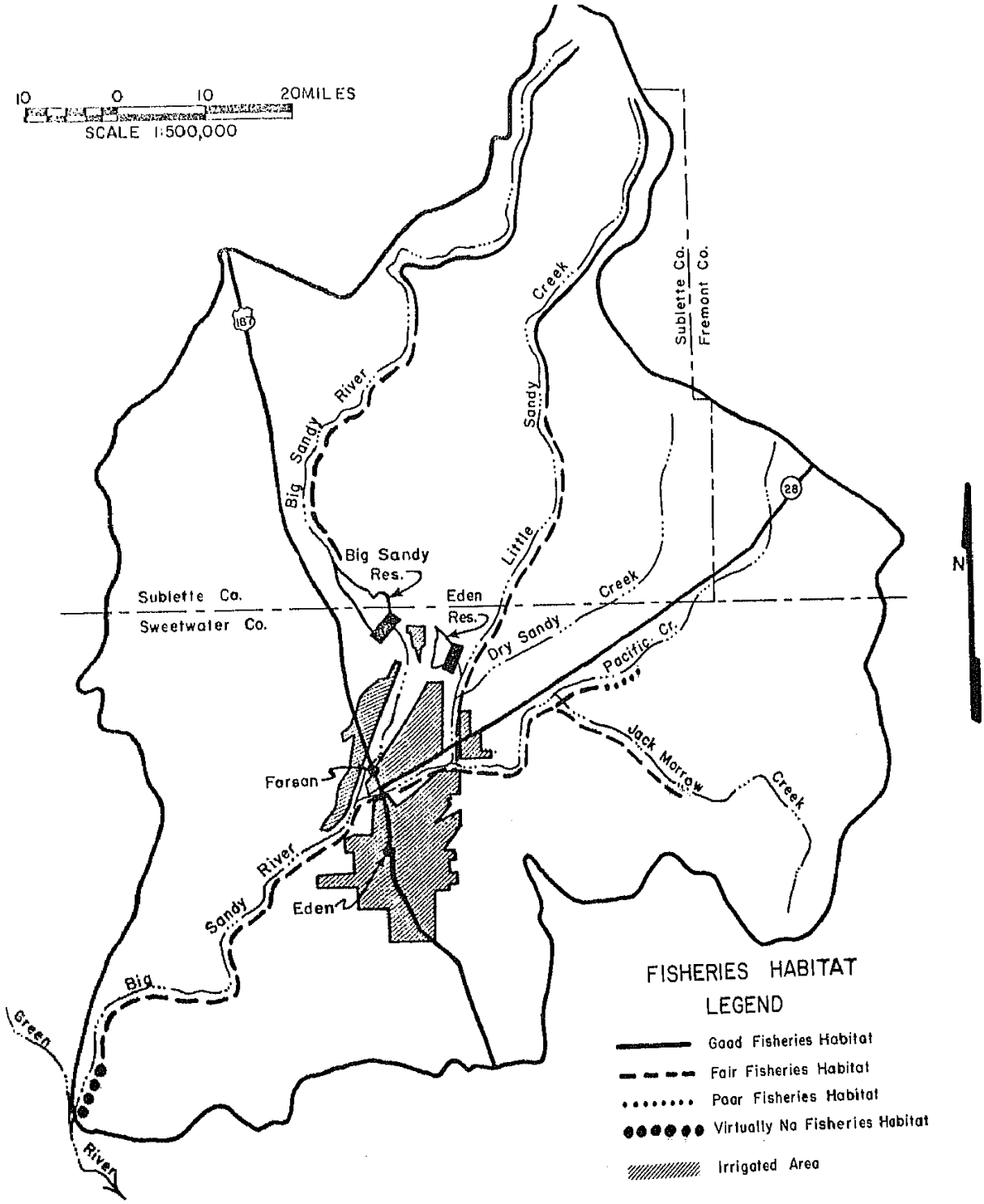


Figure A-5 Fisheries Habitat
Big Sandy River Watershed, Wyoming

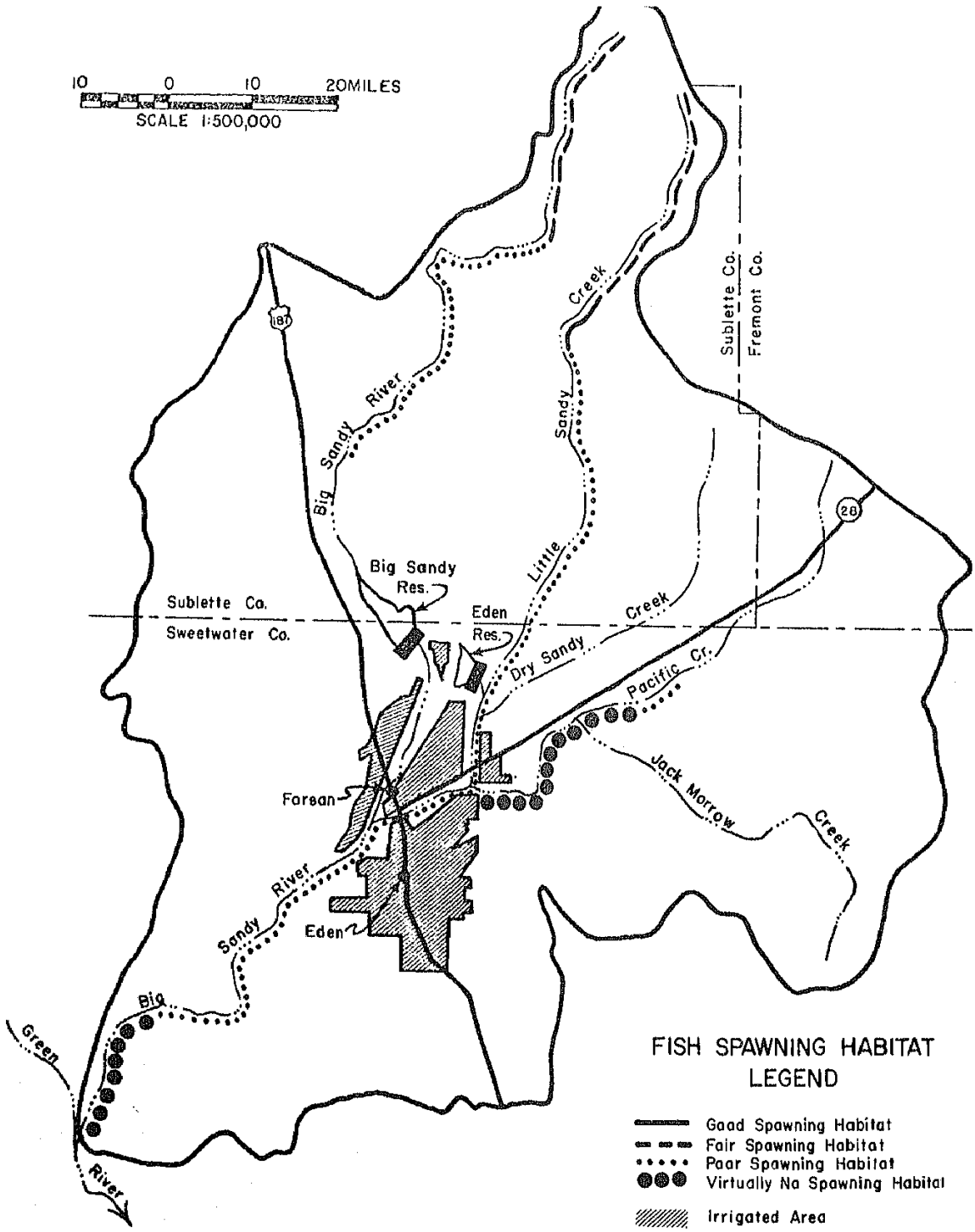


Figure A-6 Fish Spawning Habitat
Big Sandy River Watershed, Wyoming

distribution in a predominately cold desert biome that is considered ecologically important to the area. Principal fish species present in the lower Big Sandy River and Little Sandy Creek consist of rainbow and brown trout, carp, and suckers.

The lower Big Sandy River extends 40 miles from the town of Farson to the confluence with the Green River. This reach of stream is high in nutrients. It has fair to poor resident trout habitat throughout. Major limiting factors for salmonids are excessive summer temperature maximums and heavy accumulation of sediments. Populations of trout are known to exist in this reach of the Big Sandy when temperature levels are acceptable, especially in the 8 - 10 mile region of cold water bank seeps below Farson. Some of these seeps create quarter to half-mile reaches of perennial cold water streams (e.g., Bone Draw) which feed the Big Sandy and offer the only potential salmonid spawning habitat on the lower river.

This reach of the Big Sandy is also of major importance for nongame fish, primarily minnow and sucker species which migrate upstream from the Green River in March and April in order to spawn in the extensive deposits of sand and fine gravel lining the river bottom. Three nongame fish species which inhabit the lower Sandy (roundtail chub, flannelmouth sucker, and bluehead sucker) have been significantly reduced in Wyoming in the past two decades. No federally listed threatened or endangered fish species have been identified in the study area. The following species occur in the Colorado River system downstream from the Big Sandy River Unit Study Area: Colorado squawfish (listed), humpback chub (listed), bonytail chub (proposed), and the razorback sucker (proposed).

The two major reservoirs, the Eden Reservoir and the Big Sandy Reservoir, provide game fisheries habitat. The Eden and Big Sandy Reservoirs are major irrigation water storage reservoirs for the Eden Project. The former is a relatively shallow reservoir (15 feet) which may winterkill. Fish common to both the Big and Little Sandy Rivers are present in the reservoir. The Big Sandy Reservoir maintains a population of brown trout and contains a small number of cutthroat trout. Rainbow trout occur incidentally in the reservoir.

Wildlife

The wildlife in the watershed is primarily a composite of native terrestrial animal communities that depend upon specific vegetative types or other animals in the community for food. Some of these animals are closely tied to a particular plant community or vegetative type while others range throughout the study area and adjacent areas. See Table A-6. Many animal species may be found in the study area throughout the year, while some migrate into the study area for certain seasons of the year. See Table A-7.

Pronghorn antelope, mule deer, elk and moose are the major big game species found in the watershed. The Wyoming Game and Fish Department currently manages the population of these species on a hunt area-herd unit basis. Antelope and mule deer are common sights in and near the irrigated lands. Big game distributions are shown in Figures 7, 8, 9, and 10.

Table A-6 Animal Species Representative of the Big Sandy River Unit Study Area, Listed According to Similarities in Habitat Requirements, Habits or Life Form *

GROUP I In the study area, these animals are heavily dependent upon sagebrush for food or cover or nesting sites or combination thereof and/or other upland shrubs such as greasewood, saltbush and rabbitbrush, especially for winter feed.	Pronghorn Antelope Mule Deer Elk Sagebrush Vole Deer Mouse Least Chipmunk White-tailed Prairie Dog White-tailed Jack Rabbit Desert Cottontail Sage Grouse Sage Sparrow Lark Sparrow Brewer's Sparrow Sage Thrasher Lazuli Bunting Green-tailed Towhee Flycatcher, spp. Sagebrush Lizard
GROUP II In the study area, these animals feed heavily on seeds and/or foliage or roots of weedy species of forbs or annual grasses and/or nest on ground in open grasslands.	Northern Grasshopper Mouse Thirteen-lined Ground Squirrel Richardson's Ground Squirrel Northern Pocket Gopher Ord's Kangaroo Rat Gray-Crowned Rosy Finch Mourning Dove Lark Bunting Savannah Sparrow Grasshopper Sparrow Vesper Sparrow Horned Lark
GROUP III In the study area, these animals nest on the ground in open grasslands and/or feed primarily on perennial grass seeds or foliage.	Prairie Vole Chestnut Collared Longspur McCown's Longspur
GROUP IV In the study area, these animals depend primarily on the riparian (streamside) plant associations and/or marshy or moist meadow areas around lakes or ponds to directly or indirectly provide food or cover or nesting or breeding sites or combinations thereof.	Raccoon Mink Striped Skunk Beaver Muskrat Water Shrew Long-tailed Vole Black-billed Magpie Red-shafted Flicker Wilson's Snipe Eastern Kingbird Traill's Flycatcher Goldfinch Catbird Long-billed Marsh Wren Brown Thrasher Robin Yellow Warbler Yellowthroat Long-tailed Chat Brown-headed Cowbird Wandering Garter Snake
GROUP V In the study area these animals usually require the open pine timber, juniper breaks or rough, rocky topography for cover or food or nesting sites or a combination thereof.	Mountain Cottontail Elk Bushy-tailed Wood Rat Porcupine Pygmy Nuthatch Pinon Jay Pika Yellow-bellied marmot
GROUP VI These animals are somewhat wide-ranging and/or highly flexible predators. They prey, to varying extents, on members of most other groups. Their presence, abundance, and distribution are influenced primarily by availability of prey species; in some species, their presence is strongly influenced by the availability of nesting, trees, den sites, or burrows.	Coyote Red Fox Bobcat Long-tailed Weasel Black-footed Ferret ** Badger Great Horned Owl Burrowing Owl Long-eared Owl Short-eared Owl Cooper's Hawk Red-tailed Hawk Swainson's Hawk Rough-legged Hawk Ferruginous Hawk Bald Eagle Golden Eagle Marsh Hawk Prairie Falcon Sparrow Hawk Peregrine Falcon ** Lynx ** Great Basin Gopher Snake **
GROUP VII The composition of insect and spider population and relative abundance of different taxonomic groups vary with season, vegetation type and stage of succession. There is generally a greater variety of species and a greater abundance of individuals in the intermediate stages of grassland succession than in either the early or climax stages. Invertebrates are one of the three major groups of grazing animals.	Invertebrates including a wide variety of insect families and spiders such as: Springtails Long-horned Grasshopper Short-horned Grasshoper Barklice Thrips Plant Bugs Lace Bugs Seed Bugs Leafhoppers Aphids Ground Beetles Carrion Beetles Dermestid Beetles Darkling Beetles Snout Beetles Moths Midges Mosquitoes Wasps Ants Harvestmen Wolf Spiders Orb Weaver Spiders
GROUP VIII These animals are all highly insectivorous, if not totally so; their presence, density, and distribution is significantly influenced by the status of local insect populations.	Long-eared Myotis Little Brown Bat Vagrant Shrew Masked Shrew Grasshopper Mouse Common Nighthawk Western Kingbird Say's Phoebe Bank Swallow Cliff Swallow Eastern Bluebird Mountain Bluebird Northern Shrike Loggerhead Shrike Starling Meadowlark Short-horned Lizard
GROUP IX Members of these animal groups found within the study area exhibit from high to total dependence upon stream, lake, or pond-marsh biotic communities for continued existence.	Waterfowl, Shorebirds, Amphibians, and Fish: Grebes Herons Geese Ducks Sandpipers Snipe Avocets Phalaropes Salamanders Frogs Toads Trouts Minnows Suckers

* SOURCE: Ecology Consultants, Inc. 1976a, 1976b, and 1976c; BLM 1974.

** These animals are known to have occurred in the study area; however, because of their scarcity, they cannot be considered as representative fauna.

Table A-7 Occurrence of selected important wildlife species, Big Sandy River Unit Salinity Study, Wyoming

Species	Season of Use
Peregrine Falcon	Y (Resident and Migrant)
Prairie Falcon	Y (Resident and Migrant)
Black-Footed Ferret	Y (Resident)
Western Burrowing Owl	S (Migrant)
Pronghorn Antelope	Y (Resident)
Mule Deer	Y (Resident)
Elk	Y (Resident)
Shiras Moose	Y (Resident)
Sage Grouse	Y (Resident)
Ducks	S (Migrant)
Coyote	Y (Resident)
Golden Eagle	Y (Resident and Migrant)
White-Tailed Prairie Dog	Y (Resident)
Cottontail Rabbit	Y (Resident)
Mourning Dove	Y (Resident and Migrant)
Bobcat	Y (Resident)
Horned Lark	Y (Resident)
Richardson Ground Squirrel	Y (Resident)
White-Tailed Jackrabbit	Y (Resident)
Beaver	Y (Resident)

Season of Use: Y = Yearlong S = Seasonal

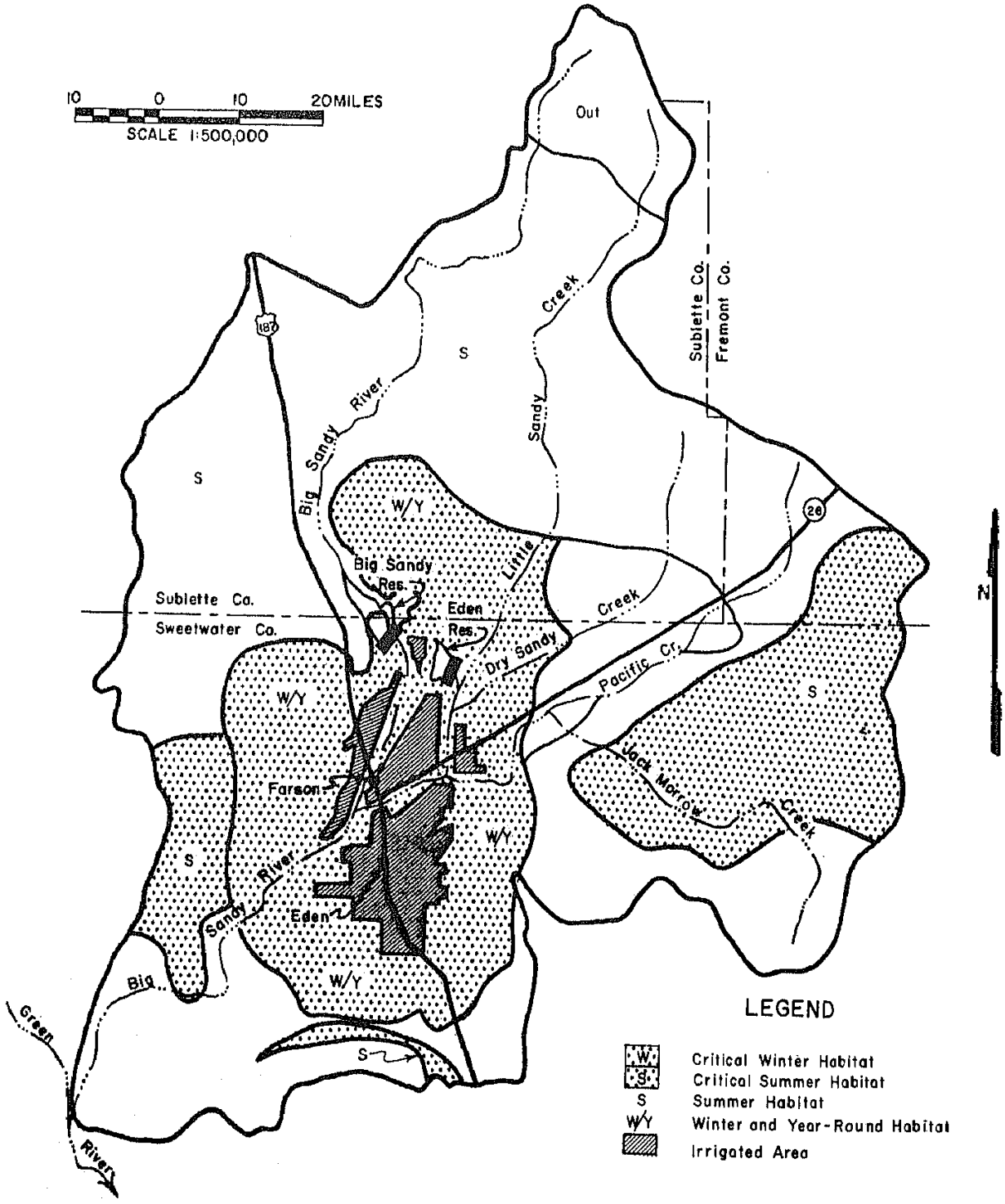


Figure A-7

Antelope Habitat
Big Sandy River Watershed, Wyoming

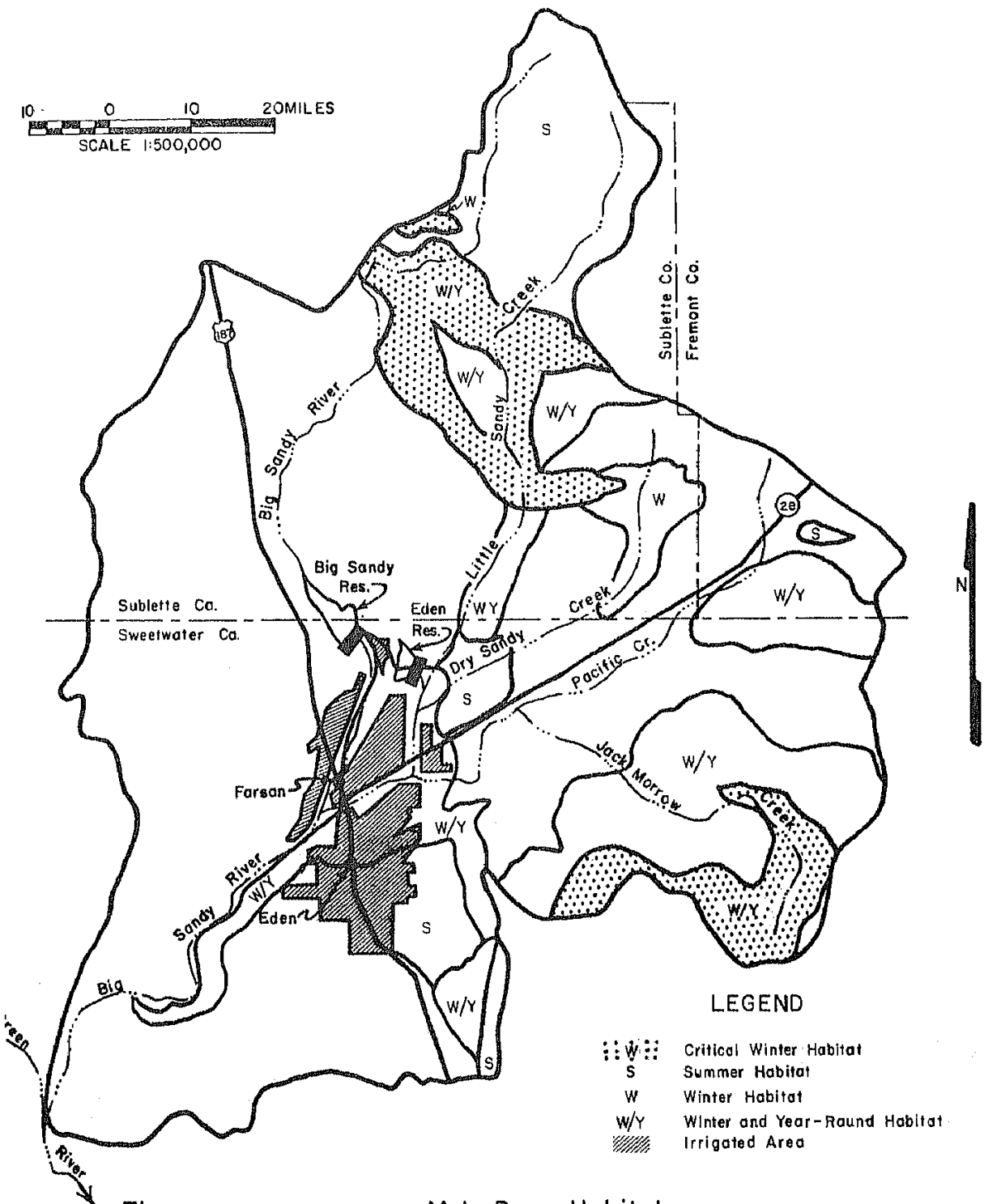


Figure A-8 Mule Deer Habitat
Big Sandy River Watershed, Wyoming

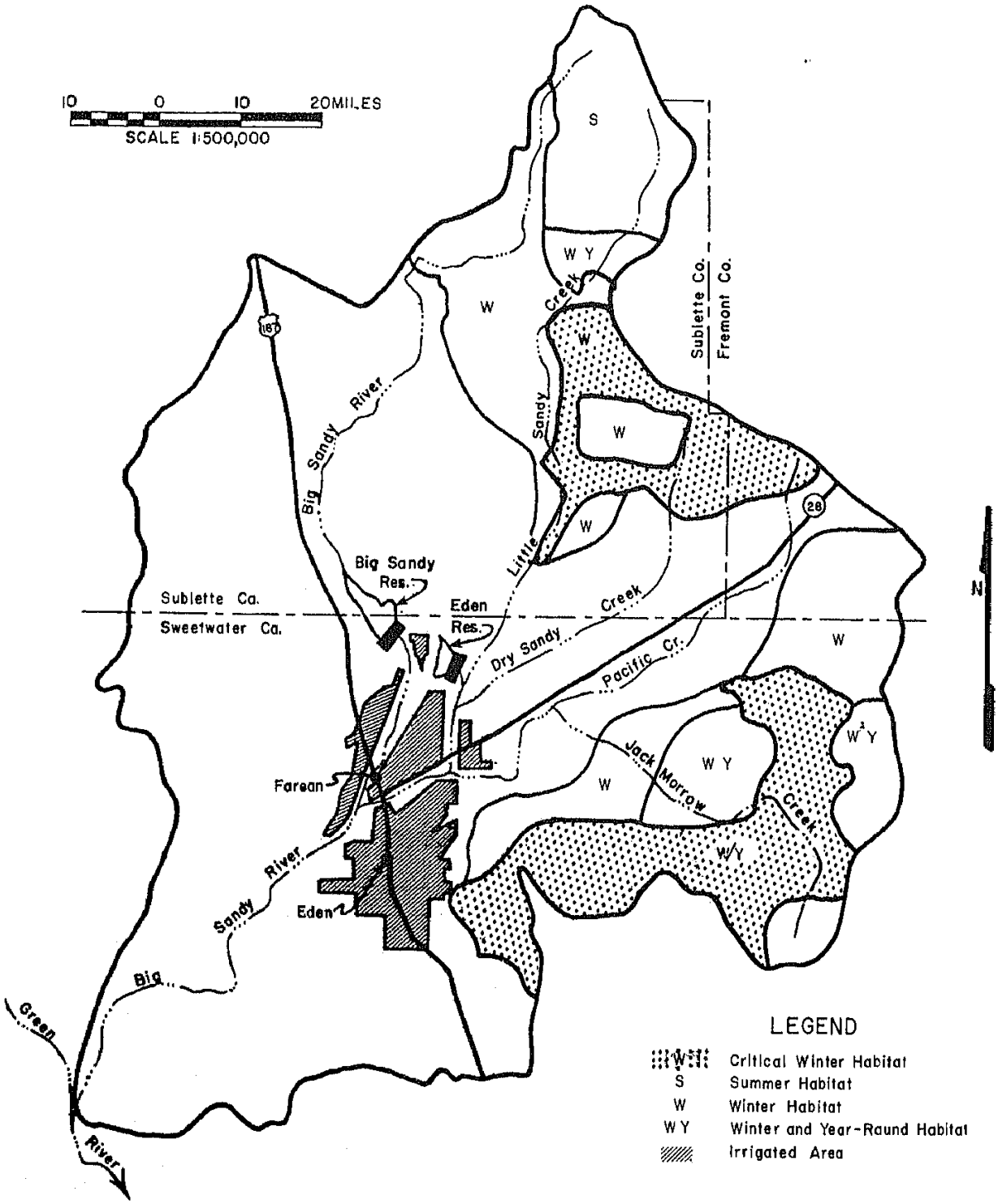


Figure A-9 Elk Habitat
Big Sandy River Watershed, Wyoming

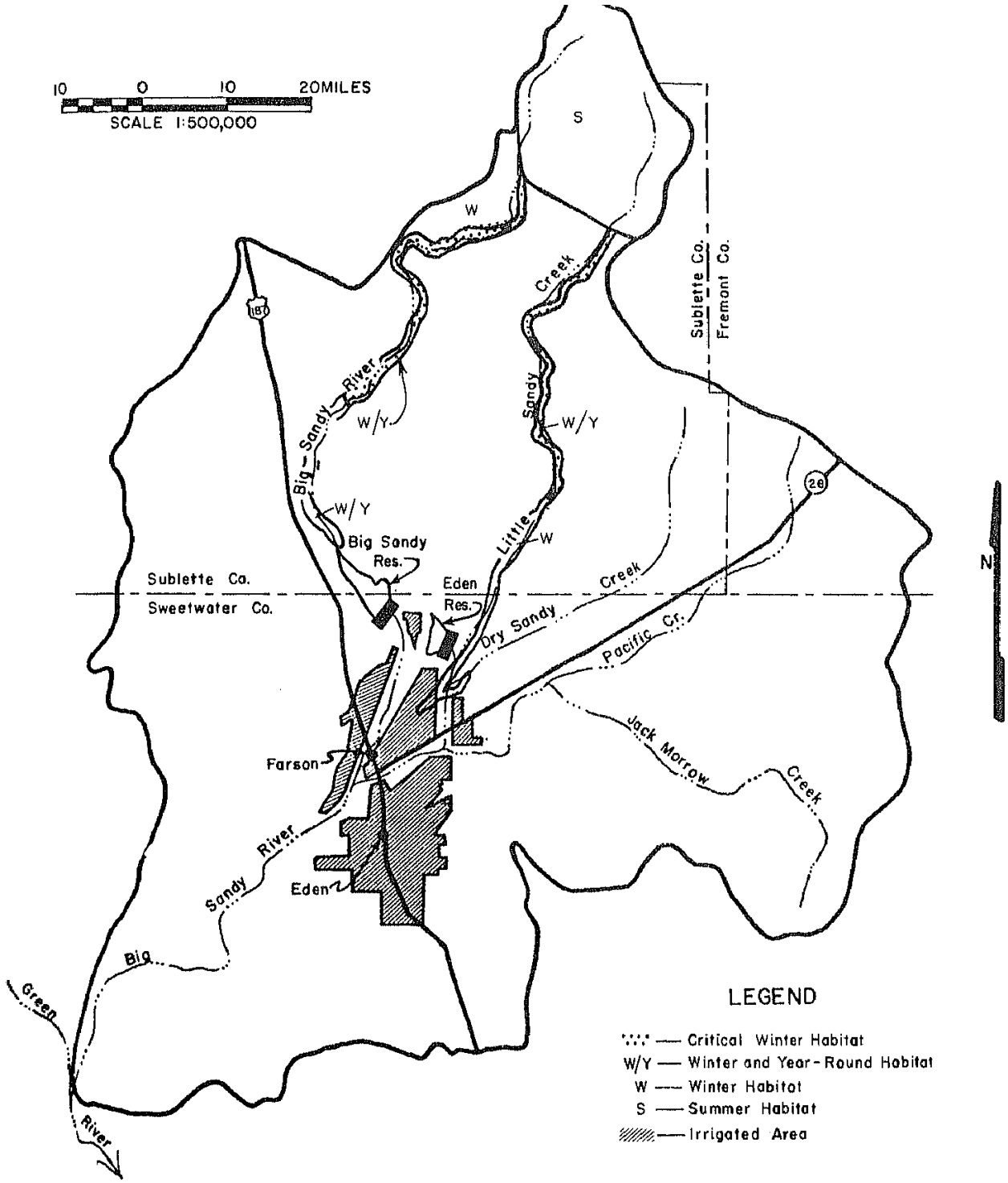


Figure A-10 Moose Habitat
Big Sandy River Watershed, Wyoming

Sage Grouse

The sage grouse is the predominate and most important gamebird inhabiting the watershed. Actual numbers of sage grouse are not known. The sagebrush-grass vegetative type is characteristically occupied by sage grouse. This vegetation covers much of the study area. Sage grouse use the irrigated lands extensively for brood rearing. Distribution and breeding complexes are displayed on Figure A-11.

Waterfowl

The study area is part of the Pacific Flyway. Important habitat for ducks consists of nesting, brood rearing and resting areas used during the spring, summer, and fall. These include flowing waters such as Pacific and Jack Morrow Creeks, the Little Sandy and Big Sandy Rivers. See Figure A-12. Stock ponds, reservoirs, and irrigation induced wetlands in the Big Sandy River Unit Study Area provide most of the flat water habitat. (See Figure A-13 and Table A-8).

Population estimates are sketchy. Most ducks do not reside in the study area yearlong, since winters are cold enough to freeze flowing waters as well as standing waters. Commonly observed ducks in the Big Sandy River Unit Study Area include the mallard, pintail, shoveler, American widgeon, gadwall, teal, ringnecked duck, and redhead. The Canadian goose is also commonly seen in the study area.

Nongame Species

Numerous species of nongame birds, mammals, reptiles, amphibians, and invertebrates occur in the watershed; many are yearlong residents. Information regarding abundance, distribution, and status is generally lacking. However, the greatest variety of species occurs in and near the irrigated lands.

Endangered or Threatened Wildlife Species

Those wildlife species determined by the Secretary of the Interior to be threatened with extinction are on the official endangered species list published in the Federal Register.

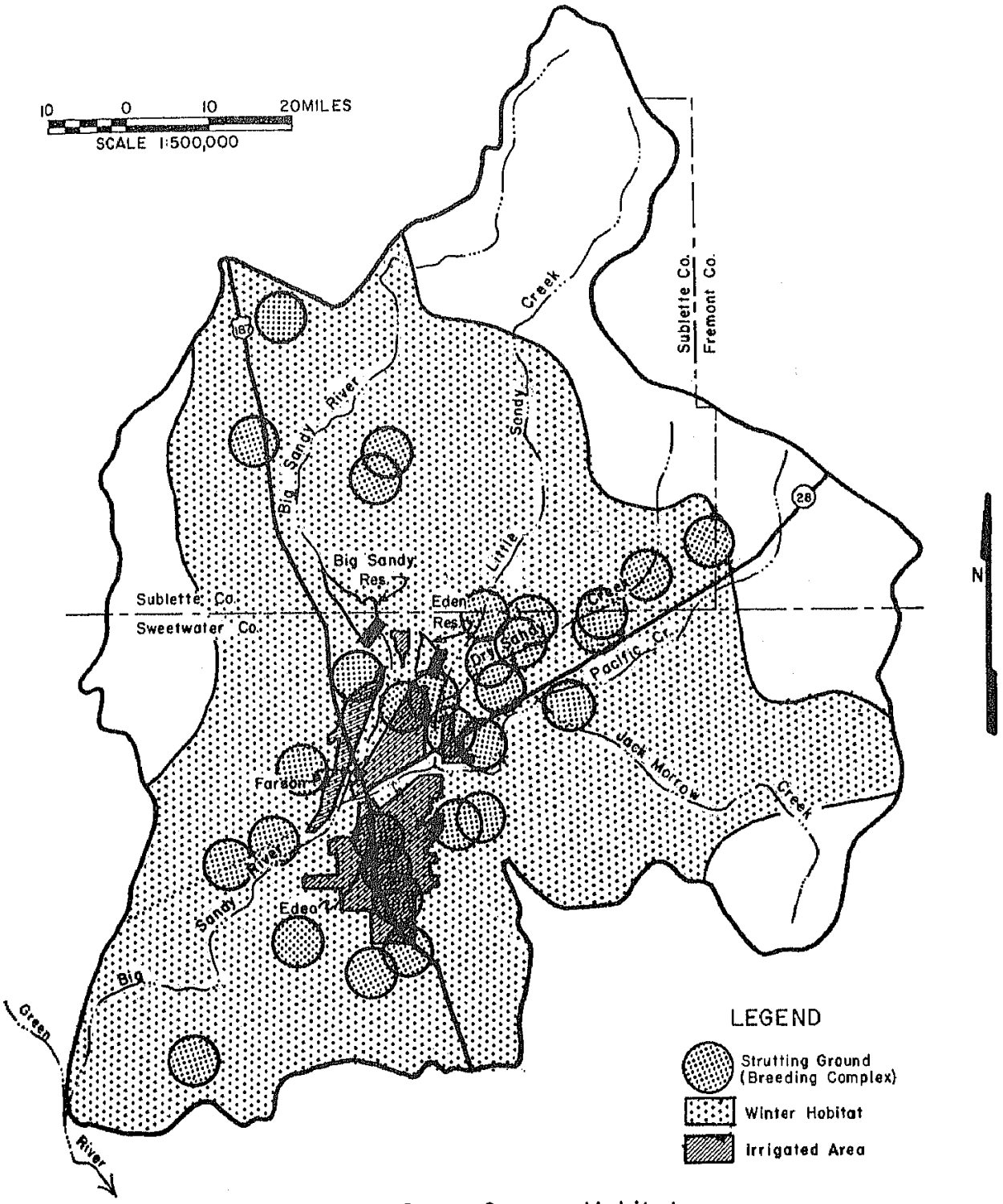


Figure A-11 Sage Grouse Habitat
Big Sandy River Watershed, Wyoming

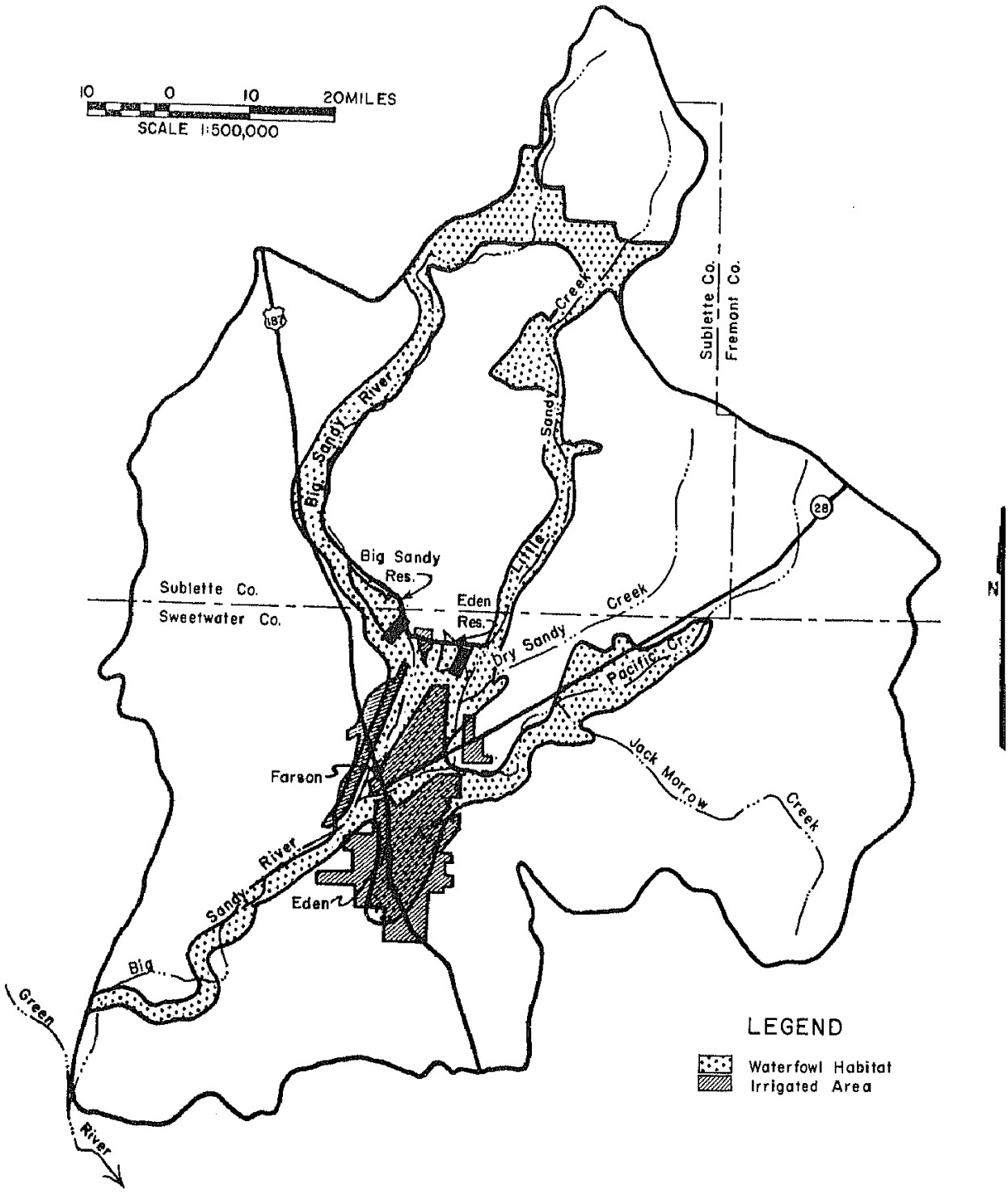


Figure A-12

Waterfowl Habitat
Big Sandy River Watershed, Wyoming

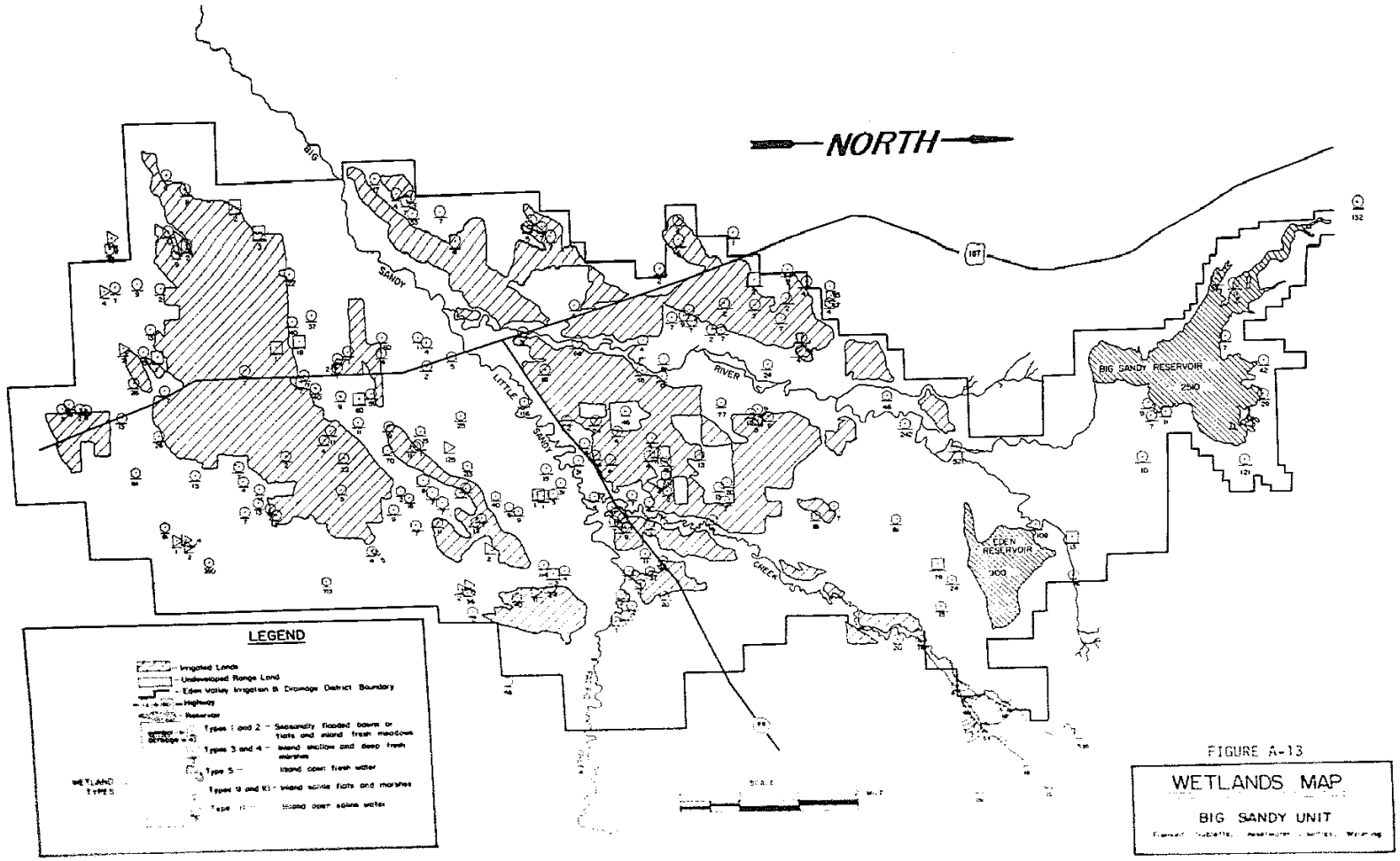


FIGURE A-13

WETLANDS MAP

BIG SANDY UNIT

Table A-8 Wetland Inventory Summary, Big Sandy Irrigated Area, 1978
Big Sandy River Unit Salinity Study, Wyoming

Wetlands (by Water Source)	No.	Total Acres	Mean Size (Ac.)	Percent of Total Wetland Area
Natural	22	2,538	121	25
Reservoir	16	3,857	32 1/	38
Surface Runoff	49	495	10	5
Subsurface & Drains (Deep percolation)	50	859	17	8
Canal	6	143	24	1
Multiple (Subsurface, Surface, Natural)	16	1,010	63	10
Dual (Surface, Subsurface)	59	1,269	22	13
	218	10,171		100

1/ Big Sandy and Eden Reservoirs (3,410 surface acres) not included in determining the mean size.

Some species, while not endangered throughout their range, have remnant populations in danger of being eliminated in local areas. This has prompted state development of the "rare and endangered" species list (Wyoming Game and Fish Department). See Table A-9.

Wild Horses

Table A-9 Possible Endangered or threatened wildlife species occuring in Big Sandy River Unit Salinity Study, Wyoming

Species Name	State Status	Federal Status
American Peregrine Falcon	Rare 1/	Endangered 2/
Prairie Falcon	Rare	
Gyrfalcon	Rare	
Osprey	Rare	
Bald Eagle	Undetermined 3/	Endangered
Goshawk	Undetermined	
Ferruginous Hawk	Undetermined	
Swainson's Hawk	Undetermined	
Western Borrowing Owl	Rare	
Shorteared Owl	Undetermined	
Great Grey Owl	Undetermined	
Snowy Owl	Undetermined	
Saw-whet Owl	Undetermined	
Screech Owl	Undetermined	
Turkey Vulture	Undetermined	
Trumpeter Swan	Rare	
Snowy Egret	Rare	
Black-Crowned Night Heron	Rare	
Long Billed Curlew	Undetermined	
Mountain Plover	Undetermined	
Upland Plover	Rare	
Black-Footed Ferret	Endangered	Endangered
River Otter	Rare	
Ringtail	Rare	
Canada Lynx	Rare	
Mountain Lion	Undetermined	
Great Basin Bull Snake	Undetermined	

1/ Although not presently threatened with extinction, is in such small numbers throughout its range that it may be endangered if its environment declines. This pertains to Wyoming only; species may have different status in other states.

2/ Prospect for survival and reproduction is in immediate jeopardy. Threatened with extinction throughout all or a significant portion of their range.

3/ In Wyoming, one that has been suggested as possibly rare or endangered but about which there is not enough information to determine its status.

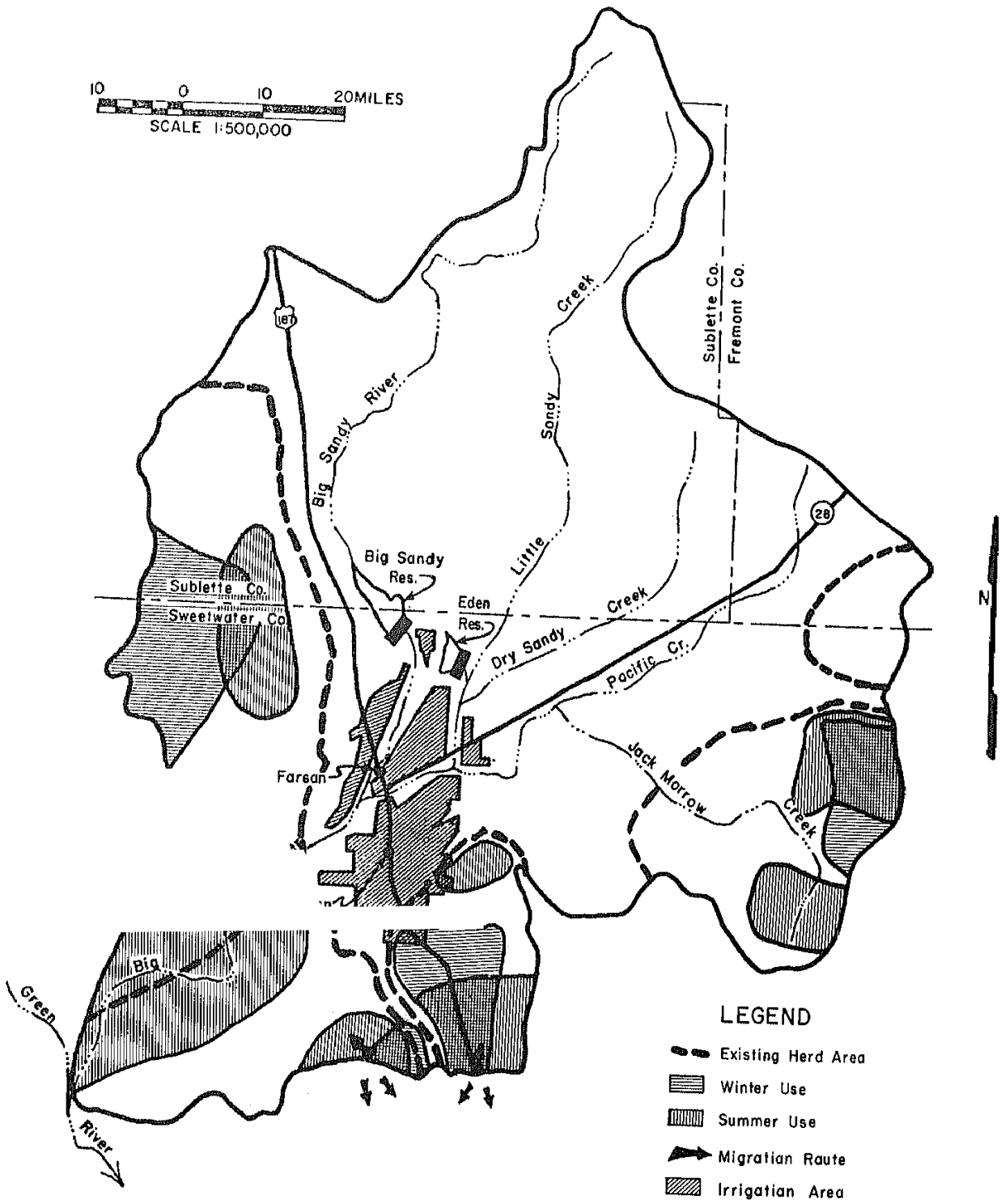


Figure A-14 Horse Management Areas.
Big Sandy River Watershed, Wyoming

Recreation

Most of the recreation use in the study area is concentrated near streams and reservoirs. Much of this use takes place at Big Sandy Reservoir, which is within the Big Sandy River Unit Area, and along the Big Sandy River and Little Sandy Creek. A response to the high volume of use has been the establishment of nine campsites.

Secondary uses in the upper watershed area are various winter sports including snowmobile use, and cross-country skiing.

Vegetative Types

The study area has eleven major vegetative types--sagebrush-grass, saltbush-winterfat, grass, meadow, greasewood, mountain shrubs, perennial forbs, conifer, irrigated cropland and pastures, barren and waste. Vegetative type is based upon the proportion and kind of native plant species that occur in an area. (See Table A-10).

Endangered or Threatened Plant Species

It is not known if any species are within the Big Sandy area; however, the possibility of their presence cannot be discounted. Two species previously found in or near the Big Sandy River Unit Study Area area have been proposed for the endangered species list. Large fruit bladderpod (Lesquerella macrocarpa) was collected in 1900 and 1901 near Steamboat Mountain and possibly near Oregon Buttes. The exact locations are not known. Box pussytoes (Antennaria arcuata) was collected in 1905 in the meadows along the Sweetwater River near Atlantic City. The U.S. Fish and Wildlife Service has indicated that precocious orophaca (Astragalus Proimanthus) may occur in the study area.

Unique Cultural, Historical, Archeological, and Visual Resources

Visual resources in the watershed were evaluated using the Bureau of Land Management's visual management classification system. The study area has areas rated as Classes II, III, IV, (Figure A-15).

Scenic quality was determined by analysis of an area's landform, color, water, vegetation, uniqueness, and intrusions. Figure A-16 shows the scenic quality and Figure A-17 indicates landscape features for the study area.

The Colorado/Sandy landscape is predominately Class IV because of monotony caused by the lack of topographic variation. Natural variations within the Colorado/Sandy landscape include the Upper Big Sandy River north of the Big Sandy Reservoir corridors and Sublettes Flat.

Paleontological Resources

The study area contains some of the most important vertebrate fossil locations in the United States. The area in the eastern portion of the watershed and adjacent areas are considered the classic Middle

Table A-10 Vegetative types and major species in the Big Sandy River Unit Salinity Study, Wyoming

Broad Vegetative Type	Major Species	Percent of Watershed
Sagebrush-grass	Big sagebrush Western wheatgrass Idaho fescue Bluebunch wheatgrass Indian ricegrass Needleandthread	76
Saltbush-winterfat	Gardner saltbush Winterfat (whitesage) Horsebrush Bottlebrush squirreltail	10
Grass	Western wheatgrass Thickspike wheatgrass Sedge species Indian ricegrass	2
Meadow - Wet & Dry	Saltgrass Tufted hairgrass Muhlenbergia spp. Sedge species	2
Greasewood	Black greasewood Western wheatgrass Bottlebrush squirreltail	5
Mountain Shrub	Snowberry Antelope bitterbrush Quaking Aspen Rose	1
Perennial Forbs	Phlox Vetch	2
Conifer	Juniper Lodgepole pine Limber pine Englemann spruce Douglas fir	1
Irrigated Cropland and Pasture 1/	Oats Alfalfa Alfalfa-Bromegrass Bromegrass	1
Barren		--
Waste		--
TOTAL		100.00

1/ Contains the 15,700 acres Eden Valley Irrigation Project.

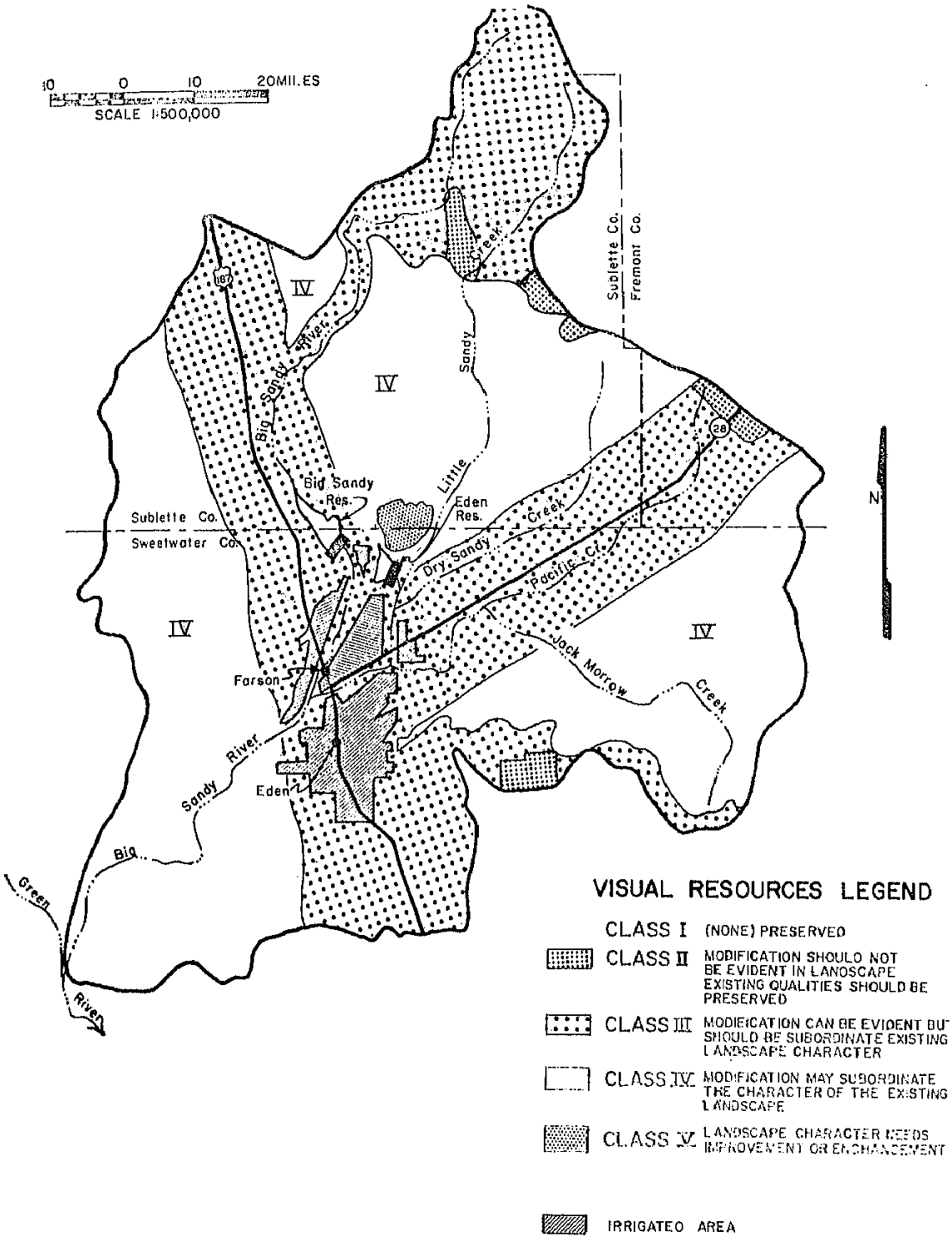
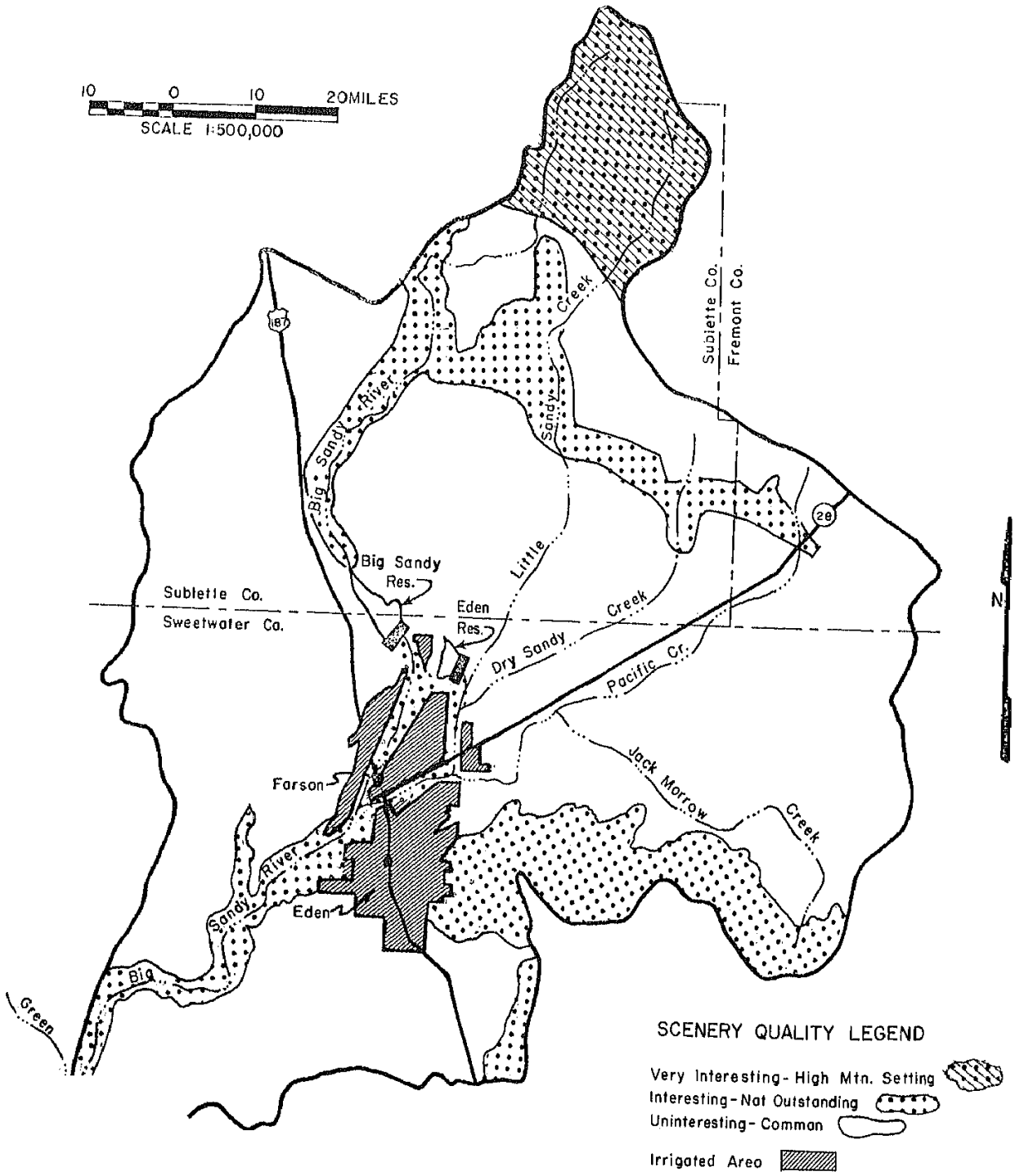


Figure A-15

Visual Resouces

Big Sandy River Watershed, Wyoming



Scenery Quality
Big Sandy River Watershed, Wyoming

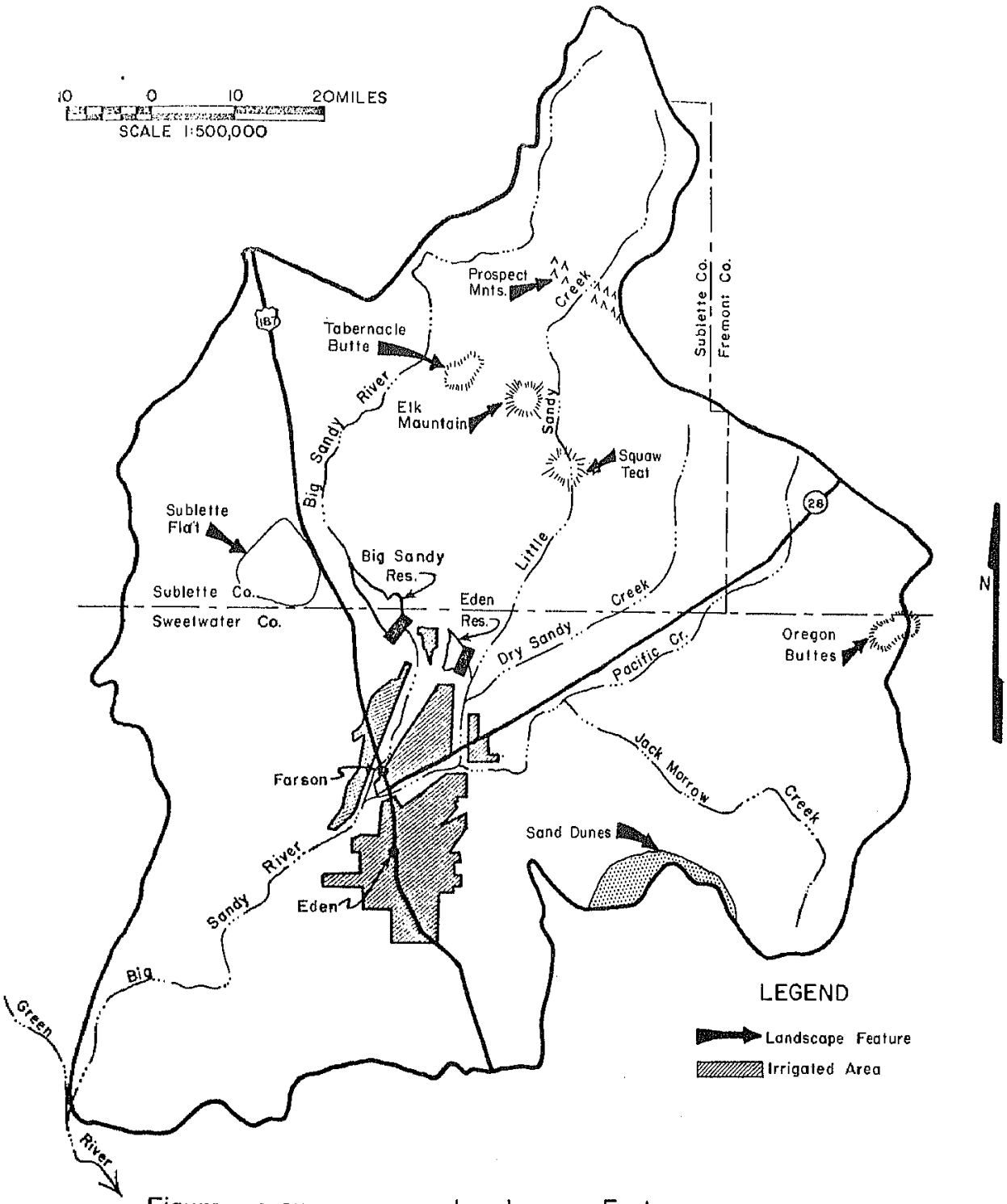


Figure A-17 Landscape Features
Big Sandy River Watershed, Wyoming

Eocene collecting ground in the world. The Eocene Period (58 million to 36 million years ago) is divided into four ages: Wasatchian (Early Eocene); Bridgerian (Middle Eocene); Uintan (Late Eocene); and Duchesnian (Very Late Eocene). In the Sandy Area, deposits of the Wasatchian and Bridgerian are found.

One of the best-known deposits of fossil fish in the United States occurs over an extensive area northeast of Farson in the Upper Little Sandy Study Area. The fish are primarily two fresh water herring genera, Knightia and Diplomystia which occur in the Laney Shale that was part of Lake Gosuite 45 to 50 million years ago.

Archeological Resources

There are 11 known archeological sites in the study area. Currently, there are no archeological sites in the watershed on the National Register of Historic Places. Several sites are potentially eligible on a national, state, or local level for nomination to the National Register by the Secretary of the Interior.

Archeological sites potentially eligible for nomination to the National Register include (level of potential nomination is in Parentheses):

Finley Site (National Level) - This is the earliest known site in southwestern Wyoming (7,000 to 9,000 years before present). Parts of it were excavated in the 1940's. It is the type site for the Eden point, which is a diagnostic of the Cody Complex, and it may contain components of the Folsom Complex. According to the Wyoming State Archeologist, much subsurface material remains at this site.

Eden-Farson Site (State Level) - A large Shoshonean campsite and antelope trap. It contained the remains of at least 12 lodges and 200 antelope. It is the largest Shoshonean camp of its type excavated.

SW 305 (State Level) - A deeply buried site in sandy soil spring. Test pits have revealed Middle Period occupation siderable material still remains, and the test pits h the bottom of the deposit.

F.G. 10 (State Level) - A very extensive, deeply stratified site around a spring and wet meadow. Test pits have revealed Late Prehistoric and Middle Period materials.

F.G. 5 (Local Level) - A large lithic scatter containing Archaic projectile points on a semi-stabilized sand dune near a spring. There is considerable depth to the site.

E.M. 4 (State Level) - A heavy concentration of lithic material over a large area of sand dunes near Jack Morrow Creek. There appears to be considerable depth of deposit.

F.G. 9 (Local Level) - A very large concentration of lithic material, including an Archaic component and fire-cracked rock.

F.G. 7 (Local Level) - A fairly extensive area of lithic material containing an Archaic component and fire-cracked rock with fair depth of deposit.

F.G. 4 (State Level) - A widespread area of lithic debritage on a sand dune near the confluence of Jack Morrow Creek and a spring-fed drainage. The site has good depth of deposit.

J.S. 4 (State Level) - A huge quarry area near a spring. While most of the site is not stratified, parts of it appear to be buried. It could contain important information concerning lithic technology.

B.F. 1 (Local Level) - A large quarry on a knoll near the Blue Forest, parts of the site have good depth of deposit.

There are numerous types of archeological sites, based upon the activities that man performed on them. In the watershed there are several major types of sites. Communal kill sites are located near an area of good grazing where the topography is suitable for channeling animals over a cliff or into an arroyo, box canyon, steep sand dune, large snowdrift or bog. Campsites can occur almost anywhere in the watershed; however, they tend to favor areas near chert or quartzite quarry areas, water, sand dunes, and southeastern ridges. Tepee rings usually cluster close to mountains and elevated areas. Petroglyphs occur on suitable rock outcrops, while quarries are located where rock material satisfactory for artifacts is found.

Based on the data obtained from the BLM contract surveys and judgment by archeologists, the probability of locating sites in any given area is shown on Figure A-18. It must be stressed that an indication of low potential does not mean that there are not sites present in a given area; the presence of microzones may significantly increase the probability of a site being present in an area currently rated as having low potential.

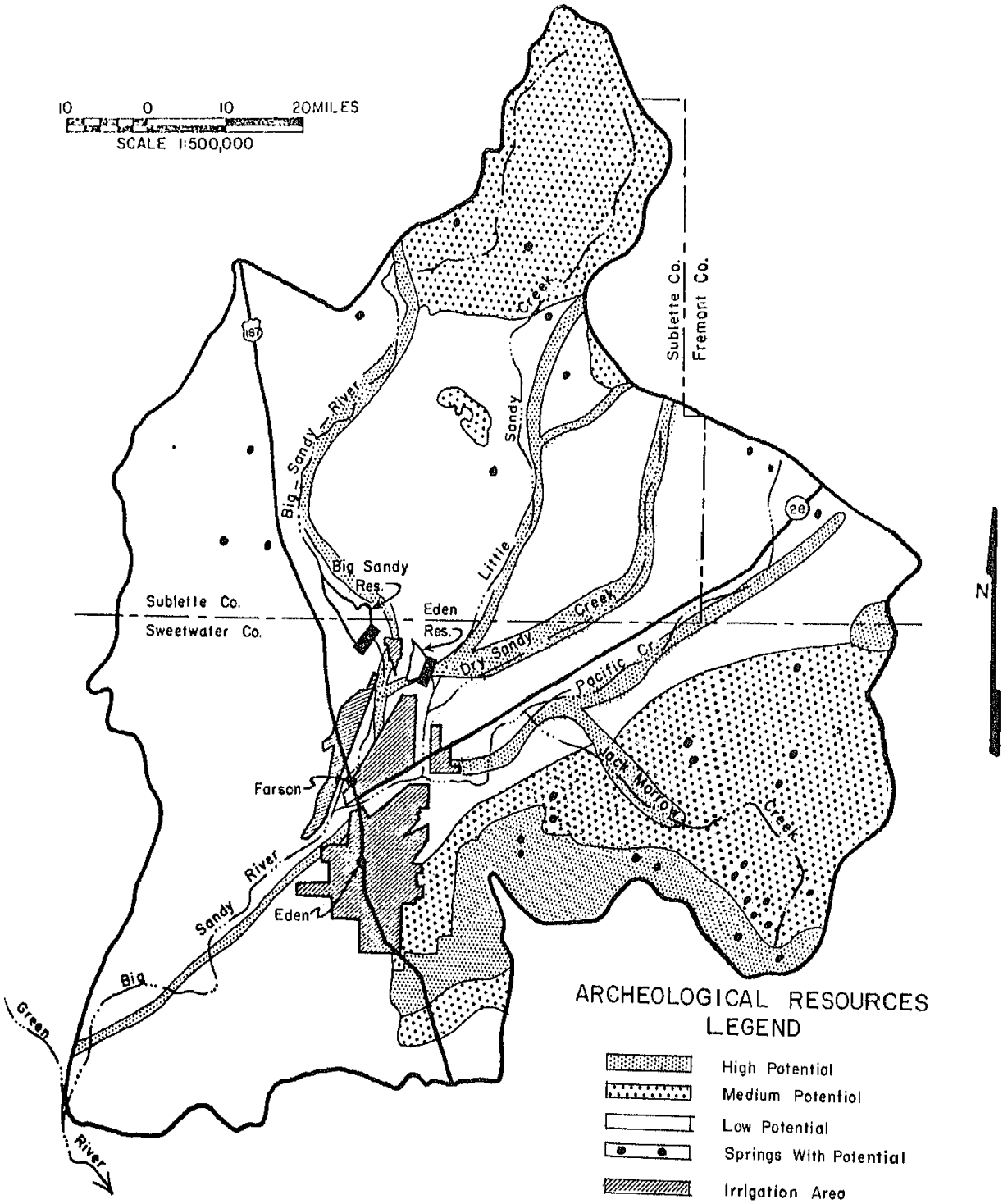


Figure A-18 Potential Archeological Resources
Big Sandy River Watershed, Wyoming

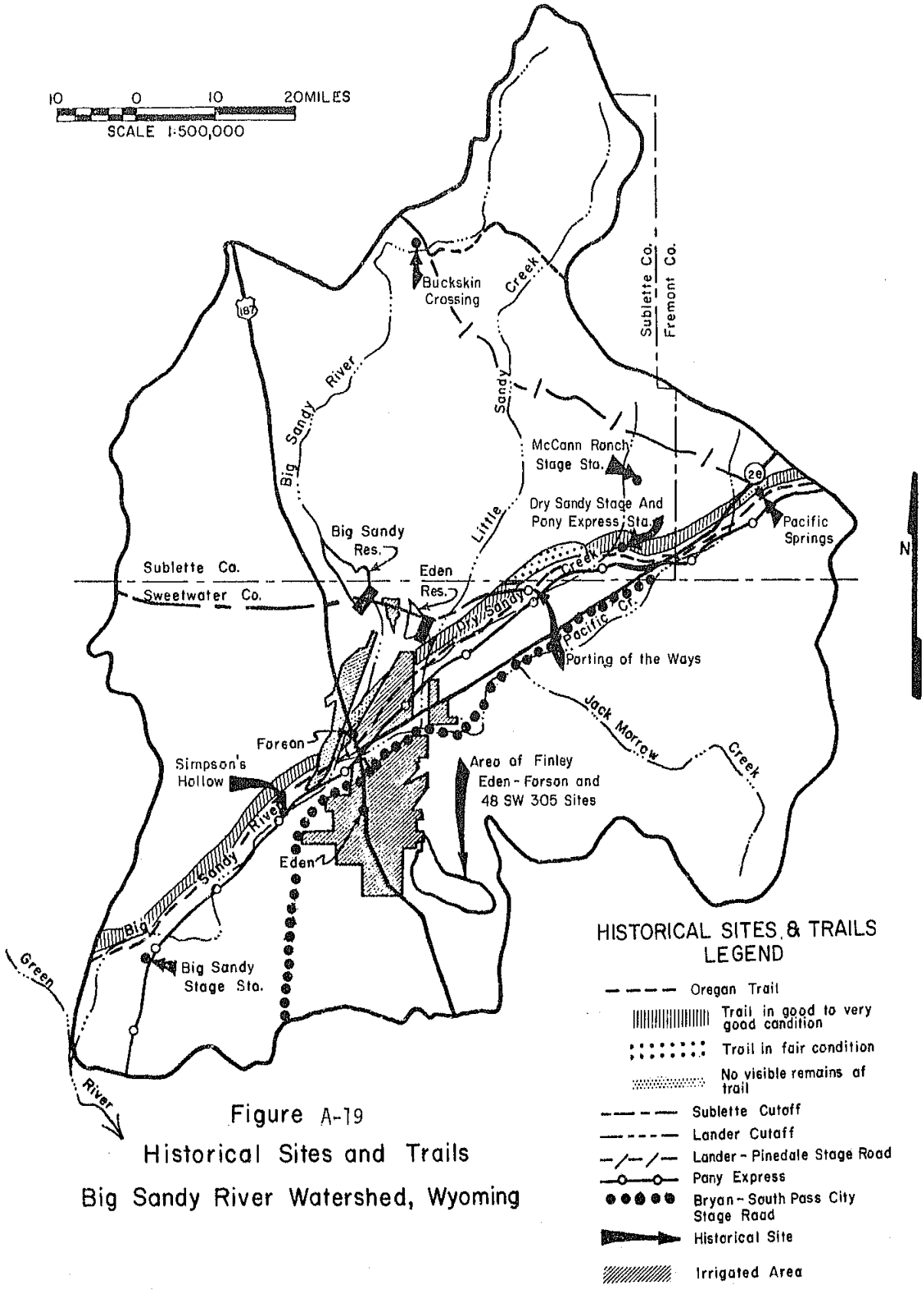


Figure A-19

Historical Sites and Trails

Big Sandy River Watershed, Wyoming

Table A-11 Significant historic trails and sites in the Big Sandy River Unit Salinity Study, Wyoming

Trail or Site	Level of Significance	Date	Remains and Significance
Bridger Route of Oregon Trail	National	1841 - 1862	The original Oregon Trail which carried most of the emigrants in its early years. Later used as a stage road and route of Mormon migration.
Sublette Cutoff (Greenwoods Cutoff)	National	1844 - 1855	The bulk of the 49ers used this trail as it saved them several days.
Lander Cutoff	National	1858 - 1862	A major army transport road also used by emigrants.
Slate Creek Cutoff	State	1852 - 1870	A road from the Oregon Trail to the Sublette Cutoff which avoided the worst part of the Sublette Cutoff.
Big Sandy Stage Station	State		Two stops on the Central Overland, California, and Pikes Peak Co. stage line, the first transcontinental stage route and an important communications link during the early stages of the Civil War. Both areas were important emigrant campsites. No surface remains are visible at either site. (Haines, 1973).
Dry Sandy Stage Station	Local	1861 - 1862	
Buckskin Crossing	State	1858 - 1862	A major campground and stream crossing on the Lander Cutoff. Trail ruts visible in the area.
McCann Ranch	Local	1900	A star route mail stop, and an early ranch in the Sandy area.
Mormon Mail Station	State	1856 - 1857	One of a number of stations built to service a mail route between Missouri and Salt Lake City, and to supply west bound Mormons. The foundation is faintly visible. (Haines, 1973).
Pacific Springs	State	1841 - 1910	This area has the longest historical occupation in the watershed, being used as an emigrant campsite, a stage and Pony Express stop, a relay station on the first transcontinental telegraph line, and an early ranch and general store. There is a ranch house, barn, and two sheds from the old ranch on the property.
Simpson's Hollow	National	1857	Wagons carrying supplies to the army advancing on Salt Lake City were burned here. This action prevented the army from reaching Salt Lake City (Haines, 1973). Ultimately this delayed statehood for Utah. There are no visible remains at the site.

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APPENDIX B

LANDOWNER QUESTIONNAIRE AND RESULTS

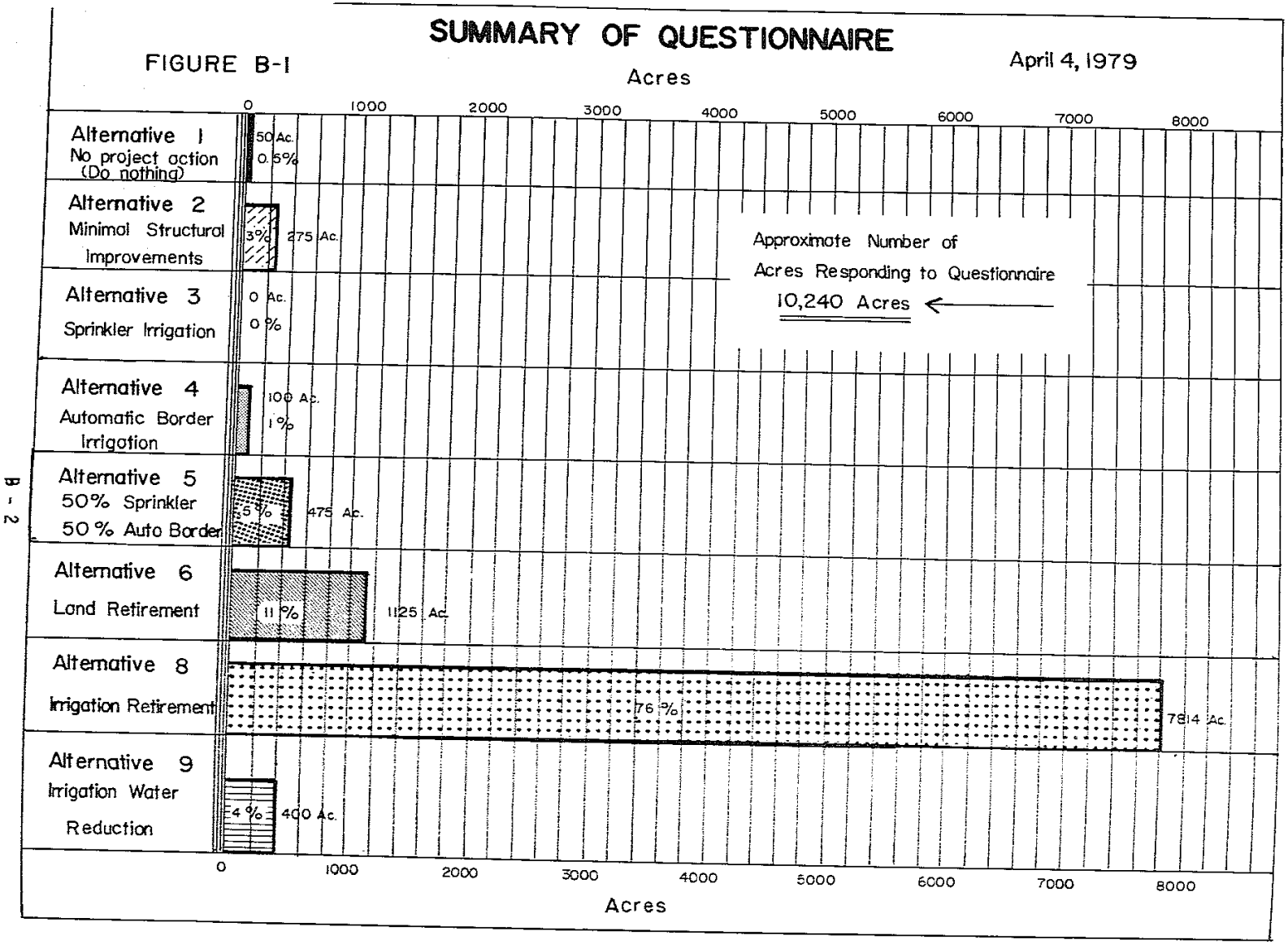
The Local Coordinating Committee after reviewing the alternatives for salinity reduction from the Eden Project area, felt they alone could not select the best alternative for implementation. The Committee called a public meeting to present the alternatives and to see if a preferred alternative could be selected. The public meeting resulted in both support and nonsupport of the alternatives. It was apparent that total unanimity for any particular alternative was not possible. As a result the Committee sent a letter to all landowners, including a Summary of Alternatives, and a Questionnaire (see Sheets A through H). The intent of their questionnaire was to develop a composite alternative which could be supported by the irrigation landowners and the Committee. Approximately 90 questionnaires were sent out to the landowners of the valley. Fifty-six percent of the questionnaires were returned, representing 10,300 irrigated acres in the project area. The results of the responses to the landowner questionnaire are tabulated on Figure B-1 (Summary of Questionnaire). It should be noted that a majority of the landowners desiring Alternatives 6 and 8 indicated that compensation for purchase of land or water rights would need to be $2,000 per irrigated acre. In addition, they indicated that the capital gains tax would need to be deferred on the purchase price or they should be given an extended reinvestment time.

Note: The dollar values used for computing average annual costs and salinity reduction benefits shown in the Summary of Alternatives used with the questionnaire are different from those shown in Chapter 3 and Appendix C. The change in the average annual cost resulted in changing the life of the project and adding replacement costs. The salinity reduction benefits changed due to a different method used to compute the salinity reduction at Imperial Dam on the Lower Colorado River.

SUMMARY OF QUESTIONNAIRE

FIGURE B-1

April 4, 1979



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March 23, 1979

Dear Landowners:

Your responses at the Big Sandy River Salinity Control public meeting, March 8, in Farson show that each alternative presented has both support and nonsupport, depending on the preferences and desires of each landowner. After review of your response, the Big Sandy Salinity Control Coordinating Committee believes that consensus for one alternative is not possible.

Therefore, in an effort to bring everyone's preferences and desires into one composite alternative, we are asking for your help. Please review the enclosed summary of alternatives discussed at the meeting, then fill out the enclosed questionnaire and return it to the Local Coordinating Committee before April 2, 1979.

The questionnaire has been developed to give an indication of the course of action you want for your farm. The results of the questionnaire will provide a guide for development of a composite alternative.

The new alternative may show as an example: 25 percent of the irrigated acres under sprinkler systems, 15 percent automated border systems, 10 percent of the irrigated area may have minimal structural improvement (renovate existing ditches, concrete turnout gates and improved water management), 20 percent may have approximately 2 acre-foot per acre delivery to their lands, 10 percent of the land may relinquish all the water rights (stop irrigation) and landowners would retain the land, 10 percent of the irrigated land be retired and landowner relocated, and 10 percent may continue the present on-farm irrigation practices and systems (do-nothing).

In addition to the on-farm solutions, Sublettes Flat evaporation and waterfowl reservoir may be installed at a size necessary to reduce the remaining agricultural salt loading.

To repeat, the percentage of irrigated land under any particular salinity reduction method will be determined by your responses to the questionnaire. You may elect to put in sprinklers while your neighbors may decide on one of the other options.

The amount of cost-share or payment for each of the irrigated land salinity reduction methods would probably be calculated on a farm by farm basis using total amount of water applied by measurement at the headgate versus nonconsumptive water losses.

We encourage you to contact anyone of us on the Coordinating Committee, if you have any questions. If we cannot answer them, we will get the answer for you.

A public meeting at the Farson school has been tentatively scheduled on April 19, 1979, at 7:30 p.m., for the Soil Conservation Service to help us discuss the results of the questionnaire and the new composite alternative.

Big Sandy River Salinity Control Study
Local Coordinating Committee

COPY

March 23, 1979

SUMMARY OF ALTERNATIVES

ALTERNATIVE NUMBER 1: (Future Without Project or Do Nothing)

This Alternative was prepared to develop the base for the Salinity Study. It showed that Irrigated Agriculture nets an income on the average of $46.54 per acre per year. The present On-farm Irrigation Efficiency averages 34 percent, with an overall Project Efficiency of 28 percent. Salt delivery by the Big Sandy River to the Green River equals 149,300 tons per year.

ALTERNATIVE NUMBER 2: (Minimal Structural Improvements)

This Alternative consists of cleaning out farm head ditches so that they will have the capacity to carry a flow of 6 cfs. In addition, concrete turnout gates would be installed on approximately 40 percent of the project area. The remaining project lands (60 percent) have existing improved turnout gates. Two thousand five hundred acres of land will be leveled to help improve efficiency and in general the local farmer will improve on-farm irrigation water management. Cost of the project will be $1,088,000 1/ (Installation Cost) or an average annual cost of $92,110 2/. An additional $28,260 is required to operate and maintain the revised irrigation system. Therefore, the total annual cost is estimated at $120,370.

The estimated On-farm Efficiency will increase to 41 percent with overall Project Efficiency of 34 percent. Salt reduction will be 2,700 tons. Average annual benefits for works of improvement along with irrigation water management are estimated to be $268,600 of which $128,600 ($8.19 per acre) is attributed to increased agricultural output, and $140,000 from downstream salinity reduction. This Alternative shows annual $148,230 Net Beneficial effect. (Benefits ($268,600) - Costs ($120,370) = Net Benefits ($148,230).

ALTERNATIVE NUMBER 3 & 3A: (Sprinkler Irrigation)

These 2 Alternatives were presented at the public meeting, but cost to provide the system plus operation and maintenance

1/ This cost is the dollar value required to install works of improvement the first time and includes labor, equipment, materials, etc.

2/ This cost is an annual cost which is obtained by amortizing the installation cost at 6 7/8 percent interest for its useful life (or until it requires replacement).

exceeded the benefits. Therefore, they will not be shown on the Questionnaire.

Alternative 3 provided a pumping plant at the reservoir with the entire distribution system in a pipeline. Installation Cost = $79,800,000.

Alternative 3A provided 6 pumping plants along the present canal system. Pumping was done to groups of farms. This Alternative would require a Water Wasteway System for use should the power fail to the pumping plant. Installation Cost = $36,820,000.

ALTERNATIVE NUMBER 3B: (Sprinkler Irrigation)

This Alternative consisted of individual pumping plants for each farm. An on-farm distribution pipeline would replace the existing open ditches. On-farm sprinklers would be optional siderolls or center pivot. This Alternative would require a Water Wasteway System to be used if the power failed the on-farm pumping plants.

The cost of this project would be about $13,439,000 (Installation Cost) or an average annual cost of $1,208,280. In addition, $413,300 3/ would be required for operation and maintenance. Therefore, the total average annual cost will be $1,621,580.

The estimated On-farm Efficiency will increase to 68 percent with an overall Project Efficiecy of 56 percent. Salt reduction will be 52,900 tons per year.

The average annual benefits for this total sprinkler system alternative will be $2,964,300 of which $271,400 or ($17.29 per acre) will come from increased agricultural output and $2,692,900 from downstream salt reduction.

This Alternative showed a net Beneficial Effect of $1,342,720 annually.

ALTERNATIVE NUMBER 4: (Automated Border Irrigation for 14,200 acres in the project area and 1,500 acres of sprinklers with individual pumping plants)

This Alternative will consist of lining all the on-farm ditches. The type of lining would be optional. The existing border systems

3/ Operation Cost = $240,640 which is the power cost to run a sprinkler system for the valley.

Maintenance Cost = $172,660 which is the cost to repair sprinklers, pipe, pumps, and motors for the system.
$240,640 + $172,660 = $413,300 is an Annual Cost.

would be used and automatic gates or semi-automatic gates would be used to turn the water from one border to another. This would give the farmer the opportunity to set entire fields at one time. This Alternative would require more irrigations per season. Larger streamflows per border with less time per border set. The 1,500 acre designed as subirrigated would be converted to sprinkler irrigation because soils will not allow an efficient border irrigation system. In addition, 5,000 acres will be land leveled. This will be done on those fields which are presently being contour irrigated and to those fields that may require a change of border width and/or length.

The cost of this Alternative is estimated at $11,641,000 (Installation Cost) or an average annual cost of $1,169,100. In addition, $258,900 would be required for operation and maintenance. Therefore, the average annual cost of this Alternative would be $1,428,000.

The estimated On-farm Efficiency will increase to 62 percent with an overall Project Efficiency of 51 percent. Salt reduction downstream would be 42,600 tons per year.

Average annual benefits for this irrigation system will be $2,503,500 of which $336,900 or ($21.46 per acre) will come from increased agricultural output and $2,166,600 from downstream salt reduction. This Alternative showed a net Beneficial Effect of $1,075,500 annually.

ALTERNATIVE NUMBER 5: (Fifty percent of the project area (Alternative #3B) Sprinkler Irrigated and 50 percent (Alternative #4) Automated Border Irrigated)

This Alternative was provided to show a combination irrigation system approach. Automated border irrigation and sprinkler irrigation which could go hand in hand throughout the valley. Structural features would be the same as that discribed in Alternative 3B and 4.

Cost of installation is estimated at $12,221,000 or an average annual cost of $1,169,400. In addition, the operation and maintenance cost would be $334,800. Therefore, the total average annual cost of this Alternative would be $1,504,200.

The estimated On-farm Efficiency will increase to 65 percent with an overall Project Efficiency of 53 percent. Oownstream salt reduction will be 47,976 tons annually.

Average annual benefits for this irrigation system will be $2,751,700 of which $310,000 or ($19.75 per acre) will come from increased agricultural output and $2,441,700 from downstream salt reduction. This Alternative showed a net Beneficial Effect of $1,247,500 annually.

March 23, 1979

ALTERNATIVE NUMBER 6: (Land Retirement)

This Alternative would retire all the irrigated land. The existing irrigated land would revert back to rangeland. The landowner would be compensated for loss of agricultural production by being paid a mutually agreeable value for land, equipment and buildings, farmhouse, appraisal expense, cost to retire project mortgage, and moving expenses. The average composite value per acre of irrigated land is estimated to be $1,238 4/. In addition, the businesses in the area if displaced will be purchased along with the owner's home if desired and moving expenses will be provided. It should be noted that other businesses and small acreage landowners who do not irrigate would have the option to remain without selling. The cost of this Alternative is estimated at $27,515,100 (first cost) or $1,893,400 average annual cost.

The estimated salt reduction would be 124,900 tons per year. This would provide Downstream Benefits of $6,504,500 per year.

The net Beneficial Effect of this Alternative is $4,611,100 per year.

NOTE: There was no Alternative 7.

ALTERNATIVE NUMBER 8: (Irrigation Retirement)

This Alternative would retire the irrigation from the project area. The irrigated land would revert back to improved rangeland. Landowners would remain on the farm. The landowner would be compensated for loss of agricultural production by being paid a mutually agreeable value for giving up water rights, improvements, irrigation, farm equipment, cost to haul hay and develop stock water for dryland cattle operation. The cost would be $20,992,700 (first cost) or $1,523,100 average annual cost. The average composite value per acre of irrigated land is estimated to be $1,394 5/.

This Alternative would reduce salt loading to the Big Sandy River by 124,900 tons per year. The benefits would be $6,504,500 per year.

4/ The estimated cost to purchase the irrigated land, range and idle land, farmhouse, farm buildings and equipment, moving expenses, appraisal fees and retirement of the Eden Project mortgage were summed and was divided by the total irrigated acres to arrive at the $1,238 per Irrigated Acre.

The net Beneficial Effect of this Alternative is $4,981,400 per year.

ALTERNATIVE NUMBER 9: (Irrigation Water Reduction)

This Alternative as presented would limit the landowner to approximately 2.0 acre-feet per acre. The landowner would sign an agreement for reduced water use. If the landowner with the reduced water supply irrigates his total acreage and produces a crop, negotiations would be made for compensation. If the landowner used the reduced water supply to only irrigate a portion of his irrigated acreage a reduced compensation would be made because more water would be going to deep percolation.

This Alternative would give the landowner many options to increase on-farm efficiency, which would be left to his discretion. The cost is variable depending on landowner commitment and could range from an estimated ($50.00 per acre per year to a maximum of $90 per acre per year) 6/. If everyone irrigated all their land the cost would be approximately $1,426,300 annually, or $90 per acre per year. The landowner and/or government may want a lump sum payment rather than an annual payment for this contract of reduced water use. The estimated on-farm efficiency is variable and could range from 45 percent to 62 percent. Salt reduction could range from 14,400 ton to 42,600 ton annually. Annual benefits would also be variable and could range from $780,300 to $2,503,500.

This Alternative will show a range of annual net benefit from 0 to $1,075,500.

ALTERNATIVE NUMBER 10: (Pump saline water from wells near seep area to Sublettes Flat)

This Alternative looked at the possibility of pumping the water from wells near the seep area to Sublettes Flat for storage and evaporation. This would require development of water production wells, pumping plants and pipeline to the Flat. An approximate 20 foot high dam would be required to provide storage capacity of approximately 13,400 acre-feet. The dam would provide a reservoir or lake of about 8,000 surface acres. In consultation with the Fish and Wildlife Service and Wyoming Game and Fish about Sublettes Flat, they have expressed an interest in making the resulting lake into a waterfowl refuge. Even though the water will become very saline it would be used by bird populations for feeding and nesting.

This Alternative was evaluated with the present condition of irrigation.

6/ Negotiable payment for reduced water use which results in salinity reductions. Values listed are estimates only and not intended to set the value of payment.

The cost would be approximately $9,751,000 (Installation Cost) or an average annual cost of $689,600. In addition, $319,100 would be required for operation and maintenance. The total average annual cost would be $1,008,700.

Salt reduction would be 81,300 ton annually for a benefit of $3,290,500.

The net Beneficial Effect would be $2,281,800 annually.

This Alternative could be used at a lesser size and in conjunction with any of the other alternatives presented.

NOTE: All Alternatives presented with the exception of Number 1 and 10 would require mitigation (moderation) of wetland losses within the farm area. The mitigation would include installation of various items to save, maintain, and enhance some of the more important wetlands that would be lost if water tables were re lowered as a result of less water applied to the farms. If enough support is indicated the Sublettes Flat alternative can be included with any of the alternatives presented. If Sublettes Flat is desired, this would eliminate the need for on-farm mitigation of wildlife habitat losses. Sublettes Flat will create many times over the amount of habitat lost and would also further reduce salt loading to the Big Sandy River.

COPY

March 23, 1979

Local Coordinating Committee
Big Sandy River Salinity Control Study

QUESTIONNAIRE

Check the alternative or course of action that you as a landowner would desire for your farm.

ALTERNATIVE #1	No Project Action (Do Nothing)	☐
ALTERNATIVE #2	Minimal Structural Improvements	☐
ALTERNATIVE #3B	Sprinkler Irrigation (Individual On-farm Pumps)	☐
ALTERNATIVE #4	Automated Border Irrigation (Ditch lining, etc.)	☐
ALTERNATIVE #5	50 Percent Sprinkler System, 50 Percent Automated Border System	☐
ALTERNATIVE #6	Land Retirement (Landowner Relocated)	☐
ALTERNATIVE #8	Irrigation Retirement (Landowner to Stay On-farm)	☐
ALTERNATIVE #9	Irrigation Water Reduction (Approximately 2 Ac.ft/Ac.)	☐

ALTERNATIVE #10

Pumping saline water to Sublettes Flat Reservoir to be used for a wildlife refuge and evaporation of saline water. Reservoir would be included in consolidated Alternative, size will depend on amount of remaining agricultural salt loading.

Support Concept ☐ Do Not Support Concept ☐

Comments, recommendations, or questions regarding salinity reduction to the Big Sandy River.

_____

_____

_____

*Please return Questionnaire in enclosed envelope to:
Big Sandy Coordination Committee, % P.O. Box 74,
Farson, Wyoming 82932

LAND IRRIGATED

Please check the box that approximates your irrigated acreage.

0-25 ☐	100-150 ☐	250-300 ☐	500-700 ☐
25-50 ☐	150-200 ☐	300-400 ☐	700-1000 ☐
50-100 ☐	200-250 ☐	400-500 ☐	

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Four Account Display of Impacts

for Alternatives 2, 3B, 4, 5, 6, 9, 10, and 11

FIGURE C-1 ALTERNATIVE - 2

WATER MANAGEMENT, MINIMAL ON-FARM STRUCTURES

FOUR ACCOUNT DISPLAY OF IMPACTS -- BIG SANDY RIVER UNIT SALINITY CONTROL STUDY, WYOMING

NATIONAL ECONOMIC DEVELOPMENT ACCOUNT

Components	Measure of Effects (Average Annual Dollars) 1/
BENEFICIAL EFFECTS	
A. The value of users of increased outputs of goods and services.	
1. Increased Agricultural Production Eden Valley	$128,000
2. Downstream Salinity Reduction	
a. State of Wyoming	15,000
b. Lower Colorado River Basin	83,200 2/
TOTAL BENEFICIAL EFFECTS	$226,200

Components	Measure of Effects (Average Annual Dollars) 1/
ADVERSE EFFECTS	
A. Irrigation	
1. Construction Cost ($942,000)	$ 69,330
2. Technical Assistance ($145,990)	10,740
3. Maintenance	28,260
4. Replacement	12,910
Subtotal	$121,240
B. Wetland Mitigation	
1. Installation ($293,040)	$ 21,570
2. Technical Assistance ($42,300)	3,110
3. Water Cost	3,150
4. Operation, Maintenance, & Replacement	9,610
Subtotal	$ 37,440
TOTAL ADVERSE EFFECTS	$158,680 3/

NET BENEFICIAL EFFECTS

$67,520

ENVIRONMENTAL QUALITY ACCOUNT

Components	Measure of Effects
BENEFICIAL AND ADVERSE EFFECTS	
A. Quality consideration of water, land and air resources.	1. Reduce TDS by 1.20 mg/l in the Green River at Green River, Wyo. and by .20 mg/l in the Colorado River at Imperial Dam, Calif. 2. Reduce Big Sandy River salt loading to the Green River from 157,600 tons annually to 154,900. 3. Increase hayland production by an average 0.1AU tons/ac./yr. 4. Conserve water by improving on-farm irrigation efficiency from 39 percent to 41 percent and project efficiency from 32 percent to 34 percent.
B. Areas of natural beauty.	
C. Biological resources and selected eco-systems.	1. Reduce flows in seeps below the Big Sandy Reservoir. 2. Reduce water supplies to 3,632 wetland acres of Types 1, 2, 3, 4, 9, 10, and 11. 3. Mitigate adverse effects on wetland acres of Types 3 and 4. 4. Increase waterfowl breeding in wetlands.
D. Irreversible or irretrievable commitments of resources.	1. Consume an undetermined amount of fossil fuels during construction and operation of project. 2. Commit labor for project operation and maintenance.

REGIONAL DEVELOPMENT ACCOUNT

Components	Measure of Effects (Average Annual Dollars) 1/ State of Wyoming	Rest of Nation
Income:		
BENEFICIAL EFFECTS		
A. The value of increased outputs of goods and services to users.		
1. Salinity Reduction	$ 15,000 4/	$ 83,200 2/
2. Irrigation	128,000	- -
3. Additional wages and salaries accruing to the region from implementation of:		
a. Project OM&R	41,170	-41,170
b. Wetland mitigation OM&R	9,610	-9,610
B. The value of outputs to users residing in the region from monetary external economies. 2/		
1. Indirect activities associated with increased net returns from irrigation and reduced damages from salinity reduction.	123,300	90,400
Beneficial Effects	$317,080	$ 122,820
TOTAL BENEFICIAL EFFECTS	$ 439,900	

Components	Measure of Effects (Average Annual Dollars) 1/ State of Wyoming	Rest of Nation
Costs:		
ADVERSE EFFECTS 3/		
A. The value of resources contributed within the region to achieve outputs.		
1. Multipurpose salinity reduction and irrigation improvements		
a. Project Installation	- -	$ 69,390
b. Wetland mitigation	- -	21,570
c. Project OM&R	- -	41,170
d. Wetland mitigation OM&R	- -	9,610
2. Project Administration	- -	13,850
3. Wetland Mitigation Watercost	- -	3,150
Adverse Effects	- -	$ 158,680
TOTAL COST	$ 158,680	
Net Beneficial Effects	$ 317,080	$ -35,660

Employment:

BENEFICIAL EFFECTS	Work-Years	
A. Increase in number and types of jobs.		
1. Employment for project construction	0.35 Semiskilled	- -
	1.19 Skilled	- -
2. Employment for project OM&R	4.12 Semiskilled	- -
3. Employment for accelerated land treatment	0.06 Semiskilled	- -
	0.14 Skilled	- -
4. Employment for wetland mitigation	0.17 Semiskilled	- -
	0.59 Skilled	- -
5. Indirect activity	2.61 Semiskilled	1.44
TOTAL BENEFICIAL EFFECTS	7.31 Semiskilled	1.44
	1.92 Skilled	- -

Employment:	Work-Years	
ADVERSE EFFECTS		
None		
NET BENEFICIAL EFFECTS	7.31 Semiskilled	1.44
	1.92 Skilled	- -

SOCIAL WELL-BEING ACCOUNT

Components	Measure of Effects
BENEFICIAL AND ADVERSE EFFECTS	
A. Real income distribution	1. Create 9 work-years of jobs for area residents and 1 job in lower Colorado Basin. 2. Region income benefits of $ 317,080 will be distributed by income class as follows:

INCOME CLASS($)	% in INCOME CLASS	% BENEFITS in INCOME CLASS
Less than 5,000	17	10
5,000 to 15,000	71	60
More than 15,000	12	30

B. Life, health, and safety.	1. Increased output will be in livestock production. 2. Reduction in salt will decrease cost of water treatment while enhancing water quality.

NOTE: Land treatment benefits evaluated at 7 1/8 percent interest for project life. Land treatment costs are $13,850 (Technical assistance - TA).

1/ 50-years at 7 1/8 percent interest (0.07360). Price Base 1979.

2/ Source: Salinity Management Options for the Colorado River - damage estimates and control program impacts. June 1979. Consortium of Water Resources Centers in Arizona, California, and Utah.

3/ Landowners stated they would be unable to pay for local benefit accrual. Cost distribution is all federal.

4/ Downstream in Wyoming.

SEPTEMBER 191

FIGURE C-2 ALTERNATIVE - 3B

SPRINKLER IRRIGATION

FOUR ACCOUNT DISPLAY OF IMPACTS -- BIG SANDY RIVER UNIT SALINITY STUDY, WYOMING

NATIONAL ECONOMIC DEVELOPMENT ACCOUNT

Components	Measure of Effects (Average Annual Dollars) 1/
BENEFICIAL EFFECTS	
A. The value of users of increased outputs of goods and services.	
1. Increased Agricultural Production Eden Valley	$ 271,400
2. Downstream Salinity Reduction	
a. State of Wyoming	333,300
b. Lower Colorado River Basin	2,283,600 2/
TOTAL BENEFICIAL EFFECT	$2,888,500

Components	Measure of Effects (Average Annual Dollars) 1/
ADVERSE EFFECTS	
A. Irrigation	
1. Construction Cost ($11,635,600)	$ 856,380
2. Technical Assistance ($1,803,600)	132,740
3. Operation	240,640
4. Maintenance	172,650
5. Replacement	210,640
Subtotal	$1,613,060
B. Wetland Mitigation	
1. Installation ($1,139,150)	$ 83,840
2. Technical Assistance ($159,100)	11,700
3. Water Cost	13,320
4. Operation, Maintenance, and Replacement	26,540
Subtotal	$ 135,400
TOTAL ADVERSE EFFECTS	$1,748,460 3/

NET BENEFICIAL EFFECTS

$1,140,040

ENVIRONMENTAL QUALITY ACCOUNT

Components	Measure of Effects
BENEFICIAL AND ADVERSE EFFECTS	
A. Quality consideration of water, land and air resources.	1. Reduce TDS by 26.67 mg/l in the Green River at Green River, WY and by 5.49 mg/l in the Colorado River at Imperial Dam California. 2. Reduce Big Sandy River salt loading to the Green River from 157,800 tons annually to 104,700 tons. 3. Increase hayland production by an average 0.573 tons/ac./yr. 4. Conserve water by improving on-farm irrigation efficiency from 39% to 68% and project efficiency from 32% to 50%.
B. Areas of natural beauty	1. Improve visual quality of Big Sandy River from Big Sandy Dam downstream by increasing streamflows.
C. Biological resources and selected eco-systems.	1. Change 1,615 ac. of various weedy ditch banks and border dikes to irrigated hayland. 2. Change about 14,000 ac. of hayland irrigated by flooding to sprinkler irrigation. 3. Dry up saline seeps or reduce flows in seeps below the Big Sandy Reservoir. 4. Provide additional water for instream fishery flows from Big Sandy to Geeson Bridge on release schedule recommended by the Wyoming Game & Fish Department. 5. Reduce water supplies to 1,010 wetland ac. and eliminate 2,765 wetland ac. of Types 1, 2, 3, 4, 9, 10, and 11. 6. Mitigate adverse effects on wetlands in #5 by preserving and enhancing 862 wetland ac. of Types 3, 4, and 10 and adding and enhancing 430 ac. of adjacent terrestrial habitat to wetland complexes. 7. Increase waterfowl breeding in wetland complexes.
D. Irreversible or irretrievable commitments of resources.	1. Consume an undetermined amount of fossil fuels during construction and operation of project. 2. Commit labor for project operation and maintenance.

REGIONAL DEVELOPMENT ACCOUNT

Components	Measure of Effects State of Wyoming (Average Annual Dollars) 1/	Measure of Effects Rest of Nation (Average Annual Dollars) 1/
Income:		
BENEFICIAL EFFECTS		
A. The value of increased outputs of goods and services to users.		
1. Salinity reduction	$ 333,300	$2,283,300
2. Irrigation	271,400	- -
3. Additional wages and salaries accruing to the region from implementation of:		
a. Project OM&R	623,940	-623,940
b. Wetland mitigation OM&R	26,540	-26,540
B. The value of outputs to users residing in the region from monetary external economies. 2/		
1. Indirect activities associated with increased net returns from irrigation and reduced damages from salinity reduction.	689,270	3,295,750
Beneficial Effects	$ 1,944,450	$ 4,928,570
TOTAL BENEFICIAL EFFECTS	$ 6,873,020	

Components	Measure of Effects State of Wyoming (Average Annual Dollars) 1/	Measure of Effects Rest of Nation (Average Annual Dollars) 1/
Costs:		
ADVERSE EFFECTS 3/		
A. The value of resources contributed within the region to achieve outputs.		
1. Multipurpose salinity reduction and irrigation.		
a. Project installation	- -	$ 856,380
b. Wetland mitigation	- -	83,840
c. Project OM&R	- -	623,940
d. Wetland mitigation OM&R	- -	26,540
2. Project administration	- -	144,440
3. Wetland mitigation water cost	- -	13,320
Adverse Effects	- -	$ 1,748,460
TOTAL COST	$1,748,460	
Net Beneficial Effects	$1,944,460	$ 3,180,110

Employment:	WORK-YEARS	
BENEFICIAL EFFECTS		
A. Increase in number and types of jobs.		
1. Employment for wetland mitigation	0.65 Semiskilled 1.73 Skilled	- - + -
2. Employment for project construction	3.85 Semiskilled 12.13 Skilled	- - - -
3. Employment for project OM&R	62.39 Semiskilled	- -
4. Employment for accelerated land treatment	0.80 Semiskilled 1.77 Skilled	- - - -
5. Indirect activity	13.82 Semiskilled	52.00
TOTAL BENEFICIAL EFFECTS	81.41 Semiskilled 15.63 Skilled	52.00 - -

Employment:	WORK-YEARS	
ADVERSE EFFECTS		
None		
NET BENEFICIAL EFFECTS	81.41 Semiskilled 15.63 Skilled	52.00

SOCIAL WELL-BEING ACCOUNT

Components	Measure of Effects
BENEFICIAL AND ADVERSE EFFECTS	
A. Real income distribution	1. Create 97 work-years of jobs for area residents and 52 jobs in Lower Colorado Basin. 2. Region income benefits of $1,944,450 will be distributed by income class as follows:

INCOME CLASS($)	% in INCOME CLASS	% BENEFITS in INCOME CLASS
Less than 5,000	17	10
5,000 to 15,000	71	60
More than 15,000	12	30

Components	Measure of Effects
B. Life, health, safety	1. Improve waterfowl hunting. 2. Improve stream fishing. 3. Decrease mosquito breeding areas. 4. Increased output will be in livestock production. 5. Reduction in salt will decrease cost of water treatment while enhancing water quality.

NOTE: Land treatment benefits were evaluated. Land treatment costs are included in the construction cost.

1/ 50-years at 7 1/8 percent (0.07360). Price base 1979.

2/ Source: Salinity Management Options for the Colorado River - damage estimates and control program impacts. June 1979. Consortium of Water Resources Centers in Arizona, California, Colorado, and Utah.

3/ Project evaluation resulted in insufficient local benefits to handle normal cost-sharing or OM&R. Landowners would be unable to pay for local benefit accrual.

4/ Downstream in Wyoming.

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AUTOMATED BORDER IRRIGATION (14,200 ACRES) AND SPRINKLER IRRIGATION (1,500 ACRES)

FIGURE C-3 ALTERNATIVE - 4

FOUR ACCOUNT DISPLAY OF IMPACTS -- BIG SANDY RIVER UNIT SALINITY STUDY, WYOMING

NATIONAL ECONOMIC DEVELOPMENT ACCOUNT

Components	Measure of Effects (Average Annual Dollars) 1/
BENEFICIAL EFFECTS	
A. The value of users of increased outputs of goods and services.	
1. Increase Agricultural Production Eden Valley	$ 336,900
2. Downstream Salinity Reduction	
a. State of Wyoming	270,300
b. Lower Colorado River Basin	1,888,600 2/
TOTAL BENEFICIAL EFFECT	$2,495,800

Components	Measure of Effects (Average Annual Dollars) 1/
ADVERSE EFFECTS	
A. Irrigation	
1. Construction Cost ($10,078,800)	$ 741,800
2. Technical Assistance ($1,562,200)	114,980
3. Operation	24,600
4. Maintenance	234,300
5. Replacement	302,400
Subtotal	$ 1,418,080
B. Wetland Mitigation	
1. Installation ($401,000)	$ 29,510
2. Technical Assistance ($47,700)	3,510
3. Water Cost	3,150
4. Operation, Maintenance and Replacement	10,380
Subtotal	$ 46,550
TOTAL ADVERSE EFFECTS	$ 1,464,630

NET BENEFICIAL EFFECTS

$1,031,170

ENVIRONMENTAL QUALITY ACCOUNT

Components	Measure of Effects
BENEFICIAL AND ADVERSE EFFECTS	
A. Quality consideration of water, land and air resources.	1. Reduce TDS by 21.63 mg/l in the Green River at Green River, Wyoming and by 4.54 mg/l in the Colorado River at Imperial Dam, California. 2. Reduce Big Sandy River salt loading to the Green River from 157,600 tons annually to 115,100 tons. 3. Increase hayland production by an average 0.061 tons/ac./yr. 4. Conserve water by improving on-farm irrigation efficiency from 34% to 62% and project efficiency from 32% to 46%.
B. Areas of natural beauty.	1. Improve visual quality of the Big Sandy River from Big Sandy Dam downstream by increasing streamflows.
C. Biological resources and selected eco-systems.	1. Change 142 ac. of various weedy ditch banks and border dikes to irrigated hayland. 2. Change 1,500 ac. of hayland irrigated by flooding to sprinkler irrigation. 3. Dry up saline seeps or reduce flows in seeps below the Big Sandy Reservoir. 4. Provide additional water for instream fishery flows from Big Sandy Reservoir to Gasson Bridge on release schedule recommended by the Wyoming Game & Fish Department. 5. Reduce water supplies to 1,503 wetland ac. and eliminate 130 wetland ac. of Types 1, 2, 3, 4, 9, 10, and 11. 6. Mitigate adverse effects on wetlands in #5 by preserving and enhancing 180 wetland ac. of Types 3 and 4 and adding and enhancing 90 ac. of adjacent terrestrial habitat to wetland complexes.
D. Irreversible or irretrievable commitments of resources.	1. Consume an undetermined amount of fossil fuels during construction and operation of project. 2. Commit labor for project operation and maintenance.

REGIONAL DEVELOPMENT ACCOUNT

Components	Measure of Effects State of Wyoming (Average Annual Dollars) 1/	Measure of Effects Rest of Nation (Average Annual Dollars) 1/
Income:		
BENEFICIAL EFFECTS		
A. The value of increased outputs of goods and services to users.		
1. Salinity Reduction	$ 270,300 4/	$1,888,600 2/
2. Irrigation	336,900	- -
3. Additional wages and salaries accruing to the region from implementation of:		
a. Project OM&R	561,300	-561,300
b. Wetland mitigation OM&R	10,380	-10,380
B. The value of outputs to users residing in the region from monetary external economies. 3/		
1. Indirect activities associated with increased net returns from irrigation and reduced damages from salinity reduction.	724,230	2,853,360
Beneficial Effects	$ 1,903,110	$ 4,170,280
TOTAL BENEFICIAL EFFECTS	$ 6,073,390	

Costs:	Measure of Effects State of Wyoming (Average Annual Dollars) 1/	Measure of Effects Rest of Nation (Average Annual Dollars) 1/
ADVERSE EFFECTS 3/		
A. The value of resources contributed within the region to achieve outputs.		
1. Multipurpose salinity reduction and irrigation.		
a. Project installation	- -	$ 741,800
b. Wetland mitigation	- -	29,510
c. Project OM&R	- -	561,300
d. Wetland mitigation OM&R	- -	10,380
2. Project administration (Technical Assistance)	- -	118,490
3. Wetland mitigation water cost	- -	3,150
Adverse Effects	$ - -	$1,464,630
TOTAL COST	$ 1,464,630	
Net Beneficial Effects	$ 1,903,110	$2,705,650

Employment:

BENEFICIAL EFFECTS	WORK-YEARS	
A. Increase in number and types of jobs.		
1. Employment for wetland mitigation	0.41 Semiskilled 0.69 Skilled	- - - -
2. Employment for project construction	7.05 Semiskilled 11.75 Skilled	- - - -
3. Employment for project OM&R	56.13 Semiskilled	- -
4. Employment for accelerated land treatment	0.69 Semiskilled 1.53 Skilled	- - - -
5. Indirect activity	14.29 Semiskilled	45.25
TOTAL BENEFICIAL EFFECTS	78.67 Semiskilled 13.97 Skilled	45.25 - -

Employment:

ADVERSE EFFECTS	WORK-YEARS
None	
NET BENEFICIAL EFFECTS	
	78.67 Semiskilled 45.25 13.97 Skilled - -

SOCIAL WELL-BEING ACCOUNT

Components	Measure of Effects
BENEFICIAL AND ADVERSE EFFECTS	
A. Real income distribution	1. Create 93 work-years of jobs for area residents and 45 jobs in Lower Colorado Basin. 2. Region income benefits of $1,903,110 will be distributed by income class as follows:

INCOME CLASS($)	% in INCOME CLASS	% BENEFITS in INCOME CLASS
Less than 5,000	17	10
5,000 to 15,000	71	60
More than 15,000	12	30

Components	Measure of Effects
B. Life, health, safety	1. Improve waterfowl hunting. 2. Improve stream fishing. 3. Decrease mosquito breeding areas. 4. Increased output will be in livestock production. 5. Reduction in salt will decrease cost of water treatment while enhancing water quality.

NOTE: Land treatment benefits were evaluated, land treatment costs are included in the construction cost.

1/ 50-years at 7 1/8 percent (0.07360). Price base 1979.

2/ Source: Salinity Management Options for the Colorado River - damage estimates and control program impacts. June 1979. Consortium of Water Resources Centers in Arizona, California, Colorado, and Utah.

3/ Project evaluation resulted in insufficient local benefits to handle normal cost-sharing or OM&R. Landowners would be unable to pay for local benefit accrual.

4/ Downstream in Wyoming.

AUTOMATED BORDER IRRIGATION (7,850 ACRES) AND SPRINKLER IRRIGATION (7,850 ACRES)

FIGURE C-4 ALTERNATIVE - 5

FOUR ACCOUNT DISPLAY OF IMPACTS -- BIG SANDY RIVER UNIT SALINITY STUDY, WYOMING

NATIONAL ECONOMIC DEVELOPMENT ACCOUNT

Components	Measure of Effects (Average Annual Dollars) 1/
BENEFICIAL EFFECTS	
A. The value of users of increased outputs of goods and services.	
1. Increased Agricultural Production Eden Valley	$ 310,000
2. Downstream Salinity Reduction	
a. State of Wyoming	304,100
b. Lower Colorado River	2,117,400 2/
TOTAL BENEFICIAL EFFECTS	$2,731,500

Components	Measure of Effects (Average Annual Dollars) 1/
ADVERSE EFFECTS	
A. Irrigation	
1. Construction Cost ($10,580,640)	$ 778,740
2. Technical Assistance ($1,660,000)	120,700
3. Operation	120,320
4. Maintenance	214,480
5. Replacement	260,150
Subtotal	$1,494,390
B. Wetland Mitigation	
1. Installation ($689,200)	$ 50,730
2. Technical Assistance ($89,310)	6,570
3. Water Cost	8,250
4. Operation, Maintenance, and Replacement	24,640
Subtotal	$ 88,190
TOTAL ADVERSE EFFECTS	$1,582,580
NET BENEFICIAL EFFECTS	$1,148,920

ENVIRONMENTAL QUALITY ACCOUNT

Components	Measure of Effects
BENEFICIAL AND ADVERSE EFFECTS	
A. Quality consideration of water, land and air resources.	1. Reduce TDS by 24.34 mg/l in the Green River at Green River, Wyo. and by 5.09 mg/l in the Colorado River at Imperial Dam, California. 2. Reduce Big Sandy River salt loading to the Green River from 157,600 tons annually to 109,870 tons. 3. Increase hayland production by an average 0.600 tons/ac./yr. 4. Conserve water by improving on-farm irrigation efficiency from 29% to 65% and project efficiency from 32% to 48%.
B. Areas of natural beauty.	1. Improve visual quality of Big Sandy River from Big Sandy Dam downstream by increasing streamflows.
C. Biological resources and selected ecosystems.	1. Change 669 acres of various weedy ditch banks and border dikes to irrigated hayland. 2. Change 6,440 acres of hayland irrigated by flooding to some other irrigation method. 3. Dry up saline seeps or reduce flows in seeps below the Big Sandy Reservoir. 4. Provide additional water for instream fishery flows from Big Sandy Reservoir to Cassa Bridge on release schedule recommended by the Wyoming Game & Fish Department. 5. Reduce water supplies to 2,436 wetland acres and eliminate 1,197 wetland acres of types 1, 2, 3, 4, 9, 10, and 11. 6. Mitigate adverse effects on wetlands in #5 by preserving and enhancing 357 wetland acres of types 3, 4, and 10 and adding and enhancing 175 acres of adjacent terrestrial habitat to wetland complexes. 7. Increase waterfowl breeding in wetland complexes.
D. Irreversible or irretrievable commitments of resources.	1. Consume an undetermined amount of fossil fuels during construction and operation of project. 2. Commit labor for project operation and maintenance.

REGIONAL DEVELOPMENT ACCOUNT

Components	Measure of Effects State of Wyoming (Average Annual Dollars) 1/	Measure of Effects Rest of Nation (Average Annual Dollars) 1/
Income:		
BENEFICIAL EFFECTS		
A. The value of increased outputs of goods and services to users.		
1. Salinity Reduction	$ 304,100 4/	$2,117,400 2/
2. Irrigation	310,000	- -
3. Additional wages and salaries accruing to the region from implementation of:		
a. Project OM&R	594,950	-594,950
b. Wetland Mitigation OM&R	24,640	-24,640
B. The value of outputs to users residing in the region from monetary external economies. 2/		
1. Indirect activities associated with increased net returns from irrigation and reduced damages from salinity reduction.	769,130	$3,227,070
Beneficial Effects	$2,002,820	$4,724,880
TOTAL BENEFICIAL EFFECTS	$6,727,700	

Components	Measure of Effects State of Wyoming (Average Annual Dollars) 1/	Measure of Effects Rest of Nation (Average Annual Dollars) 1/
Costs:		
ADVERSE EFFECTS 3/		
A. The value of resources contributed within the region to achieve outputs.		
1. Multipurpose salinity reduction and irrigation.		
a. Project installation	- -	$ 778,740
b. Wetland mitigation	- -	50,730
c. Project OM&R	- -	594,950
d. Wetland mitigation OM&R	- -	24,640
2. Project administration (Technical Assistance)	- -	127,240
3. Wetland mitigation water costs	- -	6,250
Adverse Effects	- -	$1,582,580
TOTAL COST		$1,582,580
Net Beneficial Effects	$2,002,820	$3,142,300

Employment:	WORK-YEARS	
BENEFICIAL EFFECTS		
A. Increase in number and types of jobs.		
1. Employment for wetland mitigation	0.52 Semiskilled 1.40 Skilled	- - - -
2. Employment for project construction	4.90 Semiskilled 13.29 Skilled	- - - -
3. Employment for project OM&R	59.50 Semiskilled	- -
4. Employment for accelerated land treatment	0.72 Semiskilled 1.61 Skilled	- - - -
5. Indirect activity	15.92 Semiskilled	50.42
TOTAL BENEFICIAL EFFECTS	81.56 Semiskilled 16.30 Skilled	50.42 - -

Employment:	WORK-YEARS	
ADVERSE EFFECTS		
None		
NET BENEFICIAL EFFECTS	81.56 Semiskilled 16.30 Skilled	50.42 - -

SOCIAL WELL-BEING ACCOUNT

Components	Measure of Effects
BENEFICIAL AND ADVERSE EFFECTS	
A. Real Income distribution	1. Create 98 work-years of jobs for area residents and 50 jobs in Lower Colorado Basin. 2. Region income benefits of $2,002,820 will be distributed by income class as follows:

INCOME CLASS($)	% in INCOME CLASS	% BENEFITS in INCOME CLASS
Less than 5,000	17	10
5,000 to 15,000	71	60
More than 15,000	12	30

B. Life, health, and safety.	1. Increased output will be in livestock production. 2. Reduction in salt will decrease cost of water treatment while enhancing water quality.

NOTE: Land treatment benefits were evaluated. Land treatment costs are $127,270. (Technical Assistance - TA).

1/ 50-years at 7 1/8 percent (0.07360). Price base 1979.

2/ Source: Salinity Management Options for the Colorado River - damage estimates and control program impacts. June 1979. Consortium of Water Resources Centers in Arizona, California, Colorado, and Utah.

3/ Project evaluation resulted in insufficient local benefits to handle normal cost-sharing or OM&R. Landowners would be unable to pay for local benefit accrual.

4/ Downstream in Wyoming.

LAND RETIREMENT
(Buy Out 15,700 Acres of Irrigated Farm Land)

FIGURE C-5 ALTERNATIVE - 6

FOUR ACCOUNT DISPLAY OF IMPACTS -- BIG SANDY RIVER UNIT SALINITY STUDY, WYOMING

NATIONAL ECONOMIC DEVELOPMENT ACCOUNT

Components	Measure of Effects (Average Annual Dollars) 1/
BENEFICIAL EFFECTS	
A. The value of users of increased outputs of goods and services.	
1. Downstream Salinity Reduction	
a. State of Wyoming	$ 842,200
b. Lower Colorado River	6,672,600 2/
TOTAL BENEFICIAL EFFECTS	$7,514,800

Components	Measure of Effects (Average Annual Dollars) 1/
ADVERSE EFFECTS	
A. Retirement of Project	
1. Irrigated Land ($12,560,000)	$ 924,410
2. Farm Homes ($2,660,200)	195,790
3. Farm Building and Equipment ($1,885,100)	138,740
4. Remnant Acreage ($1,218,200)	89,660
5. Moving Expense ($143,800)	10,580
6. Business Displacement ($8,048,800)	592,390
7. Dwelling Replacement ($980,700)	72,180
8. Appraisal Fee ($29,100)	2,140
9. Cost to Retire Existing Mortgage ($999,600)	73,570
10. Project Administration ($1,426,300)	104,980
Subtotal	$2,204,440
B. Wetland Mitigation	
1. Installation ($1,205,700)	$ 88,740
2. Technical Assistance ($169,400)	12,470
3. Operation, Maintenance, & Replacement	40,900
Subtotal	$ 142,110
TOTAL ADVERSE EFFECTS	$2,346,550

NET BENEFICIAL EFFECTS $5,168,250

ENVIRONMENTAL QUALITY ACCOUNT

Components	Measure of Effects
BENEFICIAL AND ADVERSE EFFECTS	
A. Quality consideration of water, land and air resources.	1. Reduce TDS by 67.40 mg/l in the Green River at Green River, Wyo. and by 16.04 mg/l in the Colorado River at Imperial Dam, California. 2. Reduce Big Sandy River salt loading to the Green River from 157,800 tons annually to 32,700 tons. 3. Increase Big Sandy River streamflow 57,600 ac.ft. annually from Reservoir to Gasson Bridge.
B. Areas of natural beauty.	1. Change 14,080 ac. of hayland cover to rangeland. 2. Improve visual quality of Big Sandy River from Big Sandy Dam downstream by increasing streamflows.
C. Biological resources and selected ecosystems.	1. Change 14,080 ac. of hayland cover to rangeland. 2. Change 2,590 ac. of various weedy ditch banks and border dikes to rangeland. 3. Dry up saline seeps or reduce flows in seeps below the Big Sandy Reservoir. 4. Provide additional water for instream fishery flows from Big Sandy Reservoir to Gasson Bridge on release schedule recommended by the Wyoming Game & Fish Department. 5. Reduce water supplies to 1,010 wetlands ac. and eliminate 2,765 wetland ac. of Types 1, 2, 3, 4, 9, 10, and 11. 6. Mitigate adverse effects on wetlands in #5 by preserving and enhancing 862 wetland ac. of Types 3, 4, 9, and 10 and adding and enhancing 430 ac. of adjacent terrestrial habitat to wetland complexes. 7. Increase waterfowl breeding in wetland complexes.
D. Irreversible or irretrievable commitments of resources.	1. Consume an undetermined amount of fossil fuels during construction and operation of project. 2. Commit labor for project operation and maintenance.

REGIONAL DEVELOPMENT ACCOUNT

Components	Measure of Effects: State of Wyoming (Average Annual Dollars) 1/	Measure of Effects: Rest of Nation (Average Annual Dollars) 1/
Income:		
BENEFICIAL EFFECTS		
A. The value of increased outputs of goods and services to users.		
1. Salinity reduction	$ 842,200 4/	$ 6,672,600 2/
2. Additional wages and salaries accruing to the region from implementation of:		
a. Project OM&R	--	--
b. Wetland mitigation OM&R	40,900	-40,900
B. The value of outputs to users residing in the region from monetary external economies. 3/		
1. Indirect activities associated with increased net returns from reduced damages from salinity reduction.	1,672,000	16,780,960
2. Returns due to change in employment.	1,184,100	--
3. Reinvestment of capital received for land, farm improvements, etc.	3,862,380	--
Beneficial Effects	$7,601,580	$23,412,660
TOTAL BENEFICIAL EFFECTS	$31,014,240	

Components	Measure of Effects: State of Wyoming (Average Annual Dollars) 1/	Measure of Effects: Rest of Nation (Average Annual Dollars) 1/
Costs:		
ADVERSE EFFECTS 3/		
A. The value of resources contributed within the region to achieve outputs.		
1. Single purpose salinity reduction.		
a. Project installation	--	$ 2,099,460
b. Wetland mitigation	--	88,740
c. Wetland mitigation OM&R	--	40,900
2. Project Administration (Technical Assistance)	--	117,450
B. The negative value of outputs to users residing in the region from monetary external diseconomies.		
1. Indirect activities associated with decreased net returns from agricultural production.	$4,290,800	--
2. Loss to region due to change in employment.	1,340,700	--
Adverse Effects	$5,631,500	$2,346,500
TOTAL COST	$7,978,560	
Net Beneficial Effects	$1,970,080	$21,066,110

Employment:

	WORK-YEARS	
BENEFICIAL EFFECTS		
A. Increase in number and types of jobs. (Change in employment required).		
1. Employment for agricultural	--	--
2. Employment for Nonagricultural	154.00 Skilled 5/	--
3. Employment for wetland mitigation	0.72 Semiskilled 1.97 Skilled	--
4. Indirect activity	32.83 Semiskilled	336.40
TOTAL BENEFICIAL EFFECTS	33.55 Semiskilled 155.97 Skilled	336.40 --

Employment:

	WORK-YEARS	
ADVERSE EFFECTS		
A. Decrease in number and types of jobs.		
1. Agricultural	-84 Skilled	--
2. Nonagricultural	-70 Skilled	--
NET BENEFICIAL EFFECTS	33.55 Semiskilled 1.97 Skilled	336.40 --

SOCIAL WELL-BEING ACCOUNT

Components	Measure of Effects
BENEFICIAL AND ADVERSE EFFECTS	
A. Real Income distribution	1. Create 36 work-years of jobs for area residents and 336 jobs in Lower Colorado Basin. 2. Region income benefits of $7,601,580 will be distributed by income class as follows:

INCOME CLASS($)	% in INCOME CLASS	% BENEFITS in INCOME CLASS
Less than 5,000	17	10
5,000 to 15,000	71	60
More than 15,000	12	30

3. Region costs of $631,500 will be borne by income class as follows:

INCOME CLASS($)	% in INCOME CLASS	% BENEFITS in INCOME CLASS
Less than 5,000	17	0
5,000 to 15,000	71	65
More than 15,000	12	35

B. Life, health, safety	1. Improve waterfowl hunting. 2. Improve stream fishing. 3. Decrease mosquito breeding areas. 4. Agricultural production losses amount to $1,485,200 annually due to retirement of irrigated land. 5. Losses to businesses within the watershed amount to $625,000 annually, and includes elimination of sales, moving expenses, building closures, and appraisal fees. 6. Reduction in salt will decrease cost of water treatment while enhancing water quality.

1/ 50-years at 7 1/8 percent interest (0.07360). Price base 1979.

2/ Source: Salinity Management Options for the Colorado River - damage estimates and control program impacts. June 1979. Consortium of Water Resources Centers in Arizona, California, Colorado, and Utah.

3/ Cost distribution is all federal. All benefits are derived from downstream salinity reduction.

4/ Downstream in Wyoming.

5/ Assume persons will change to local resource jobs in the trona, oil and coal industry, etc.

SEPTEMBER 1980

FIGURE C-6 ALTERNATIVE - 9

IRRIGATION WATER REDUCTION

FOUR ACCOUNT DISPLAY OF IMPACTS -- BIG SANDY RIVER UNIT SALINITY STUDY, WYOMING

NATIONAL ECONOMIC DEVELOPMENT ACCOUNT

Components	Measure of Effects (Average Annual Dollars) 1/ Good Management of Reduced Water	Poor Management of Reduced Water
BENEFICIAL EFFECTS		
A. The value of users of increased outputs of goods and services.		
1. Increased Agricultural Production	$ 336,900 2/	$ 0 2/
2. Downstream Salinity Reduction		
a. State of Wyoming	270,300	97,600
b. Lower Colorado River	1,100,600 4/	916,200 4/
TOTAL BENEFICIAL EFFECTS	$2,425,800	$1,012,800

Components	Measure of Effects (Average Annual Dollars) 1/ Good Management of Reduced Water	Poor Management of Reduced Water
ADVERSE EFFECTS		
A. Landowners Compensation		
1. Value of water (1.4 ac.ft./ac reduction)	($18,349,860)	($7,446,330)
	$1,350,550	$548,050
2. Project Administration	($917,530)	($372,280)
	67,530	27,400
Subtotal	$1,418,080	$575,450
B. Wetland Mitigation		
1. Installation	($401,000)	($20,510)
	$ 29,510	$ 29,510
2. Technical Assistance	($47,700)	($47,700)
	3,510	3,510
3. Water Cost	3,150	3,150
4. Operation, Maintenance, and Replacement	10,380	10,380
Subtotal	$ 46,550	$ 46,550
TOTAL ADVERSE EFFECTS	$1,464,630	$622,000
NET BENEFICIAL EFFECTS	$1,041,170	$390,800

ENVIRONMENTAL QUALITY ACCOUNT

Components	Measure of Effects
BENEFICIAL AND ADVERSE EFFECTS	
A. Quality consideration of water, land and air resources.	1. Reduce TDS by 4.54 mg/l to 2.20 mg/l in the Gree River at Green River, Wyo. and by 21.63 mg/l to 7.81 mg/l in the Colorado River at Imperial Dam California. 2. Reduce Big Sandy River salt loading to the Green River from 157,600 tons annually to 115,100 tons (Good Management) to 145,300 (Poor Management). 3. Increase hayland production by an average 0.601 tons/ac./yr. 4. Conserve water by improving on-farm irrigation efficiency from 30% to 62-34% and project efficiency from 32% to 46-32%.
B. Areas of natural beauty.	1. Improve visual quality of Big Sandy River from Big Sandy Dam downstream by increasing streamflo
C. Biological resources and selected eco-systems.	1. Change undetermined amount of various weedy ditch banks and border dikes to irrigated hayland. 2. Change undetermined amount of hayland irrigated b flooding to some other irrigation method. 3. Dry up saline seeps or reduce flows in seeps belo the Big Sandy Reservoir. 4. Provide additional water for instream fishery flo from Big Sandy Reservoir to Gasson Bridge on release schedule recommended by the Wyoming Game Fish Department. 5. Reduce water supplies to 3,503 wetland acres and eliminate 130 wetland acres of types 1, 2, 3, and 6. Mitigate adverse effects on wetlands in #5 by preserving and enhancing 180 wetland acres of types 3 and 4 and adding and enhancing 90 acres of adjacent terrestrial habitat to wetland complexes. 7. Increase waterfowl breeding in wetland complexes.
D. Irreversible or irretrievable commitments of resources.	1. Consume an undetermined amount of fossil fuels during construction and operation of project. 2. Commit labor for project operation and maintenance

REGIONAL DEVELOPMENT ACCOUNT 5/

Components	Measure of Effects State of Wyoming (Average Annual Dollars) 1/	Rest of Nation
Income		
BENEFICIAL EFFECTS		
A. The value of increased outputs of goods and services to users		
1. Salinity reduction	$ 270,300 3/	$1,808,600 4/
2. Irrigation	136,900	- -
3. Additional wages and salaries accruing to the region from implementation of:		
a. Project OM&R	- -	- -
b. Wetland mitigation OM&R	10,380	-10,380
The value of outputs to users resulting to the region from monetary external economies. 2/		
1. Indirect activities associated with increased net returns from irrigation and reduced damages from salinity reduction.	324,230	2,853,360
Beneficial Effects	$1,341,810	$4,731,580
TOTAL BENEFICIAL EFFECTS	$6,073,390	

Components	Measure of Effects State of Wyoming	Rest of Nation
Costs	(Average Annual Dollars) 1/	
ADVERSE EFFECTS 6/		
A. The value of resources contributed within the region to achieve outputs.		
1. Multipurpose salinity reduction and irrigation.		
a. Project installation and value of water	- -	$1,350,550
b. Wetland mitigation	- -	29,510
c. Wetland mitigation OM&R	- -	10,380
2. Project administration and technical assistance	- -	71,040
3. Wetland mitigation water cost	- -	3,150
Adverse Effects	$ - -	$ 1,464,630
TOTAL COST	$1,464,630	
Net Beneficial Effects	$ 1,341,810	$ 3,266,950

Employment

BENEFICIAL EFFECTS	WORK-YEARS	
Increase in number and types of jobs.		
1. Employment for wetland mitigation	0.22 Semiskilled	- -
	0.80 Skilled	- -
2. Employment for accelerated land treatment	4.05 Semiskilled	- -
	20.26 Skilled	- -
3. Indirect activity	14.29 Semiskilled	57.31
TOTAL BENEFICIAL EFFECTS	18.56 Semiskilled	57.31
	20.06 Skilled	- -

ADVERSE EFFECTS	WORK-YEARS
None	
NET BENEFICIAL EFFECTS	
	18.56 Semiskilled 57.31
	20.86 Skilled - -

SOCIAL WELL-BEING ACCOUNT

Components	Measure of Effects
BENEFICIAL AND ADVERSE EFFECTS	
A. Real income distribution	1. Create 39 work-years of jobs for area residents and 67 jobs in Lower Colorado Basin. 2. Region income benefits of $ 1,341,810 will be distributed by income class as follows

INCOME CLASS(ES)	% in INCOME CLASS	% BENEFITS to INCOME CLASS
Less than 5,000	17	10
5,000 to 15,000	71	60
More than 15,000	12	30

B. Life, health, and safety.	1. Improve waterfowl hunting. 2. Improve stream fishing. 3. Decrease mosquito breeding area. 4. Increased output will be in livestock production. 5. Reduction in salt will decrease cost of water treatment while enhancing water quality.

NOTE: Land treatment benefits evaluated. Land treatment costs at 7 1/8 percent interest for 50-year project life could range from zero to $1,340,940.

1/ 50-years at 7 1/8 percent interest (0.07360). Price base 1979.

2/ Maximum agricultural production loss for 15,700 acres could equal $-309,600 if irrigated acres are reduced. Maximum increased production is estimated to be $336,900.

3/ Downstream in Wyoming.

4/ Source: Salinity Management Options for the Colorado River - damage estimates and control program impacts, June 1979. Consortium of Water Resources Centers in Arizona, California, Colorado, and Utah.

5/ Assumed good management, only for display purposes.

6/ Cost distribution is all federal. Majority of benefits are derived from downstream salinity reduction.

SUBLETTES FLAT EVAPORATION RESERVOIR AND WILDLIFE REFUGE

FIGURE C-7 ALTERNATIVE - 10 FOUR ACCOUNT DISPLAY OF IMPACTS -- BIG SANDY RIVER UNIT SALINITY STUDY, WYOMING

NATIONAL ECONOMIC DEVELOPMENT ACCOUNT

Components	Measure of Effects (Average Annual Dollars) 1/
BENEFICIAL EFFECTS	
A. The value of users of increased outputs of goods and services.	
1. Downstream Salinity Reduction	
a. State of Wyoming	$ 401,700 3/
b. Lower Colorado River Basin	2,870,700 2/
TOTAL BENEFICIAL EFFECTS	$3,360,400

Components	Measure of Effects (Average Annual Dollars) 1/
ADVERSE EFFECTS	
A. Pumping to reservoir and evaporation of saline water.	
1. Construction Cost ($9,098,000)	$ 669,670
2. Project Administration and Engineering Services ($2,143,700)	157,700
3. Operation	241,060
4. Maintenance	78,060
5. Replacement	3,410
TOTAL ADVERSE EFFECTS	$1,150,000

NET BENEFICIAL EFFECTS

$2,210,400

ENVIRONMENTAL QUALITY ACCOUNT

Components	Measure of Effects
BENEFICIAL AND ADVERSE EFFECTS	
A. Quality consideration of water, land and air resources.	1. Reduce TDS by 38.55 mg/l in the Green River at Green River, Wyo. and by 6.92 mg/l in the Colorado River at Imperial Dam, California. 2. Reduce Big Sandy River salt loading to the Green River from 157,600 tons annually to 76,300 tons. 3. Pump 13,400 acre-feet of saline water to Sublettes Flat for eventual evaporation.
B. Areas of natural beauty.	1. Provide 8,024 acres of water surface for wildlife refuge in a high plains desert setting.
C. Biological resources and selected eco-systems.	1. Dry up saline seeps along Big Sandy River. 2. Decrease streamflow in Big Sandy River from Gasson Bridge to Green River. 3. Create a 8,024 acre complex suitable for wetland waterfowl and several other aquatic and semi-aquatic species.
D. Irreversible or irretrievable commitments of resources.	1. Change 8,024 acres rangeland to reservoir area. 2. Consume an undetermined amount of fossil fuels during construction and operation of project. 3. Commit labor for project operation and maintenance.

REGIONAL DEVELOPMENT ACCOUNT

Components	Measure of Effects State of Wyoming (Average Annual Dollars) 1/	Rest of Nation
Income		
BENEFICIAL EFFECTS		
A. The value of increased outputs of goods and services to users.		
1. Salinity Reduction	$ 401,700 3/	$ 2,870,700 2/
2. Additional wages and salaries accruing to the region from implementation of:		
a. Project OM&R	322,550	-322,550
B. The value of outputs to users residing in the region from monetary external economies. 2/		
1. Indirect activities associated with increased net returns from reduced damages from salinity reduction.	632,290	9,887,920
Beneficial Effects	$1,436,540	$12,440,070
TOTAL BENEFICIAL EFFECTS	$13,876,610	
Employment:		
BENEFICIAL EFFECTS	WORK-YEARS	
A. Increase in number and types of jobs.		
1. Employment for project construction	3.66 Semiskilled 7.64 Skilled	--
2. Employment for project OM&R	32.26 Semiskilled	--
3. Indirect activity	17.87 Semiskilled	139.02
TOTAL BENEFICIAL EFFECTS	53.79 Semiskilled 7.64 Skilled	139.02

Components	Measure of Effects State of Wyoming (Average Annual Dollars) 1/	Rest of Nation
Costs		
ADVERSE EFFECTS 4/		
A. The value of resources contributed within the region to achieve outputs:		
1. Single purpose salinity reduction reservoir		
a. Project installation	--	$ 669,670
b. Project OM&R	--	322,550
2. Project administration	--	157,700
Adverse Effects	--	$ 1,150,000
TOTAL COST	$1,150,000	
Net Beneficial Effects	$1,436,540	$11,290,070
Employment:	WORK-YEARS	
ADVERSE EFFECTS		
None		
NET BENEFICIAL EFFECTS	53.79 Semiskilled 7.64 Skilled	139.02

SOCIAL WELL-BEING ACCOUNT

Components	Measure of Effects
BENEFICIAL AND ADVERSE EFFECTS	
A. Real Income distribution	1. Create 61 work-years of jobs for area residents and 139 jobs in Lower Colorado Basin. 2. Region income benefits of $1,436,540 will be distributed by income class as follows:

INCOME CLASS($)	% in INCOME CLASS	% BENEFITS in INCOME CLASS
Less than 5,000	17	10
5,000 to 15,000	71	60
More than 15,000	12	30

B. Life, health, and safety.	1. Improve waterfowl hunting. 2. Improve stream fishing. 3. Provide wildlife refuge for various recreation activities. 4. Reduction in salt will decrease cost of water treatment while enhancing water quality.

NOTE: Land treatment benefits were not evaluated.

1/ 50 years at 7 1/8 percent interest (0.07360). Price base 1979.

2/ Source: Salinity Management Options for the Colorado River - damage estimates and control program impacts, June 1979. Consortium of Water Resources Centers in Arizona, California, Colorado, and Utah.

3/ No benefits accruing to local sponsors. Benefits accruing are all downstream.

4/ All costs are from federal funds.

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LANDOWNER PREFERRED

INCLUDES PORTIONS OF ALTERNATIVES 2, 4, 5, 6, 8, AND 9

FIGURE C-8 ALTERNATIVE - 11

FOUR ACCOUNT DISPLAY OF IMPACTS -- BIG SANDY RIVER UNIT SALINITY STUDY, WYOMING

NATIONAL ECONOMIC DEVELOPMENT ACCOUNT

Components	Measure of Effects (Average Annual Dollars) 1/
BENEFICIAL EFFECTS	
A. The value of users of increased outputs of goods and services.	
1. Increased Agricultural Production	$ 34,200
2. Downstream Salinity Reduction	
a. State of Wyoming	490,400
b. Lower Colorado River Basin	4,031,000 2/
TOTAL BENEFICIAL EFFECTS	$4,555,600

Components	Measure of Effects (Average Annual Dollars) 1/
ADVERSE EFFECTS	
A. Irrigation	
1. Construction Cost	$ 104,480
2. Technical Assistance	9,960
3. Operation	5,840
4. Maintenance	12,970
5. Replacement	15,330
Subtotal	$ 140,580
B. Land or Irrigation Retirement	
1. Retirement Cost	$2,016,640
2. Administration	100,830
Subtotal	$2,117,470
C. Wetland Mitigation	
1. Installation ($1,139,200)	$ 83,840
2. Technical Assistance ($159,060)	11,710
3. Water Cost	13,320
4. Operation, Maintenance, and Replacement	26,540
Subtotal	$ 135,410
TOTAL ADVERSE EFFECTS	$2,404,460
NET BENEFICIAL EFFECTS	$2,244,140

ENVIRONMENTAL QUALITY ACCOUNT

Components	Measure of Effects
BENEFICIAL AND ADVERSE EFFECTS	
A. Quality consideration of water, land and air resources.	1. Reduce concentration of dissolved solids by 38.25 mg/l in the Green River at Green River, WY and by 9.69 mg/l in the Colorado River at Imperial Dam, CA. 2. Reduce Big Sandy River salt loading to the Green River from 157,800 tons annually to 87,400 tons. 3. Increase hayland production by an average 0.476 tons/ac./yr. 4. Conserve water by improving on-farm irrigation efficiency for the 2,000 irrigated acres from 39% to 66% and project efficiency from 32% to 20%. 5. Water not diverted due to irrigation retirement 46,000 ac.ft.
B. Areas of natural beauty.	1. Change 12,285 ac. of hayland to range or pasture land. 2. Improve visual quality of Big Sandy River from Big Sandy Dam downstream by increasing streamflows.
C. Biological resources and selected ecosystems.	1. Change 12,205 acres of hayland cover to range or pasture. 2. Change 051 ac. of various weedy ditch banks and border dikes to rangeland. 3. Change 370 ac. of remaining hayland presently irrigated by flooding to some other irrigation method. 4. Dry up saline seeps or reduce flows in seeps below the Big Sandy Reservoir. 5. Provide additional water for instream fishery flows from Big Sandy Reservoir to Gasson Bridge on release schedule recommended by the Wyoming Game & Fish Department. 6. Reduce water supplies to 1,363 wetland ac. and eliminate 2,412 wetland ac. of types 1,2,3,4,9,10,A11. 7. Mitigate adverse effects on wetlands in #6 above by preserving and enhancing 862 wetland ac. of Types 3, 4, 9, and 10 and adding and enhancing 430 ac. of adjacent terrestrial habitat to wetland complexes. 8. Increase waterfowl breeding in wetland complexes.
D. Irreversible or irretrievable commitments of resources.	1. Consume an undetermined amount of fossil fuels during construction and operation of project. 2. Commit labor for project operation and maintenance.

REGIONAL DEVELOPMENT ACCOUNT

Components	Measure of Effects State of Wyoming (Average Annual Dollars) 1/	Measure of Effects Rest of Nation (Average Annual Dollars) 1/
Income		
BENEFICIAL EFFECTS		
A. The value of increased outputs of goods and services to users.		
1. Salinity reduction	$ 490,400 4/	$ 4,031,000 2/
2. Irrigation	34,200	- -
3. Additional wages and salaries accruing to the region from implementation of:		
a. Project OM&R	34,140	-34,140
b. Wetland mitigation OM&R	26,540	-26,540
B. The value of outputs to users residing in the region from monetary external economies. 3/		
1. Indirect activities associated with increased net returns from irrigation and reduced damages from salinity reduction.	745,770	7,261,550
2. Returns due to change in employment.	902,800	- -
3. Reinvestment of capital received for irrigation retirement, maintaining livestock operations, land and farm improvements, etc.	4,269,100	- -
Beneficial Effects	$6,522,950	$11,231,870
TOTAL BENEFICIAL EFFECTS	$17,754,820	
Employment:		
BENEFICIAL EFFECTS	WORK-YEARS	
A. Increase in number and types of jobs.		
1. Employment for wetland mitigation	1.97 Semiskilled 0.62 Skilled	- - - -
2. Employment for project construction	0.66 Semiskilled 1.78 Skilled	- - - -
3. Employment for project OM&R	3.41 Semiskilled	- -
4. Employment for accelerated land treatment	0.03 Semiskilled 0.16 Skilled	- - - -
5. Indirect Activity	14.93	145.22
TOTAL BENEFICIAL EFFECTS	21.00 Semiskilled 2.55 Skilled	145.22 - -

Components	Measure of Effects State of Wyoming (Average Annual Dollars) 1/	Measure of Effects Rest of Nation (Average Annual Dollars) 1/
Costs		
ADVERSE EFFECTS 3/		
A. The value of resources contributed within the region to achieve outputs.		
1. Multipurpose salinity reduction and irrigation.		
a. Project installation	- -	$2,121,120
b. Wetland mitigation	- -	83,840
c. Project OM&R	- -	34,140
2. Project administration	- -	122,500
3. Wetland mitigation OM&R	- -	26,540
4. Wetland mitigation water cost	- -	13,320
B. The negative value of outputs to users residing in the region from monetary external diseconomies.		
1. Indirect activities associated with decreased net returns from agricultural production	$3,744,200	- -
2. Loss to region due to change in employment.	1,022,200	- -
Adverse Effects	4,766,400	2,401,460
TOTAL COST	$7,167,860	
Net Beneficial Effects	$1,756,550	$8,830,410
Employment:	WORK-YEARS	
ADVERSE EFFECTS		
A. Decrease in number and type of job.		
1. Agricultural	9 Skilled	- -
NET BENEFICIAL EFFECTS		
	21.00 Semiskilled -6.45 Skilled	145.22 - -

SOCIAL WELL-BEING ACCOUNT

Components	Measure of Effects
BENEFICIAL AND ADVERSE EFFECTS	
A. Real income distribution	1. Create 24 work-years of jobs for area residents and 145 jobs in the Lower Colorado Basin. 2. Region income benefits of $ 6,522,950 will be distributed by income class as follows:

INCOME CLASS($)	% in INCOME CLASS	% BENEFITS in INCOME CLASS
Less than 5,000	17	10
5,000 to 15,000	71	60
More than 15,000	12	30

3. Region costs of $4,766,400 will be borne by income class as follows:

INCOME CLASS($)	% in INCOME CLASS	% BENEFITS in INCOME CLASS
Less than 5,000	17	0
5,000 to 15,000	71	65
More than 15,000	12	35

B. Life, health, safety	1. Decrease livestock grazing around wetlands. 2. Improve waterfowl hunting. 3. Increase stream fishing opportunities. 4. Increased output will be in livestock production. 5. Reduction in salt will decrease cost of water treatment while enhancing water quality. 6. Agricultural production losses amount to $1,296,900 annually due to retirement of irrigation water.

NOTE: Land treatment benefits were evaluated, Land treatment costs are included in the construction cost.

1/ 50-years at 7 1/8 percent (0.07360). Price base 1979.

2/ Source: Salinity Management Options for the Colorado River - damage estimates and control program impacts. June 1979. Consortium of Water Resources Centers in Arizona, California, Colorado, and Utah.

3/ Project evaluation resulted in insufficient local benefits to handle normal cost-sharing or OM&R. Landowners would be unable to pay for local benefit accrual.

4/ Downstream in Wyoming.

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